Baltimore Aircoil Company

BAC Variable Frequency Drives

User Manual

August 2006

August 2006

Important Notice – Please Read

The product discussed in this literature is subject to terms and conditions outlined in Baltimore Aircoil Company selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Baltimore Aircoil Company selling policy.

NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Baltimore Aircoil Company or Eaton Electrical Inc. be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.

The information contained in this manual is subject to change without notice.

August 2006

August 2006

Table of Contents

SAFETY x
Definitions and Symbols. x
Hazardous High Voltage x
Warnings, Cautions and Notices xi

CHAPTER 1 — OVERVIEW 1-1
How to Use This Manual. 1-1
Receiving and Inspection 1-1
Catalog Numbering System 1-2

CHAPTER 2 — MOUNTING OPEN TYPE 1, TYPE 12 DRIVES 2-1
Space Requirements 2-1
Environmental Requirements. 2-2
Standard Mounting Instructions 2-2

CHAPTER 3 — POWER WIRING (OPEN DRIVES) 3-1
Guidelines 3-1
UL Compatible Cable Selection and Installation 3-2
Installation Instructions. 3-4
Standard Wiring Diagrams and Terminal Locations 3-7
Power and Motor Wiring Terminal Photos 3-10
Checking the Cable and Motor Insulation 3-16

CHAPTER 4 — CONTROL WIRING 4-1
General Information 4-1
Control Wiring Details. 4-3

CHAPTER 5 — BYPASS FEATURE/MAINTENANCE AND INSTALLATION 5-1
Product Description. 5-1
Catalog Numbering System 5-1
Dimensions 5-2
Power Wiring 5-5
Bypass Control Wiring Instructions 5-18

CHAPTER 6 — MENU INFORMATION 6-1
Keypad Operation 6-1
Main Menu Navigation 6-4

CHAPTER 7 — START-UP 7-1
Safety Precautions. 7-1
Sequence of Operation 7-2

CHAPTER 8 — BAC TEMP F/C APPLICATION (SVCHS302/SVCHS304) 8-1
Introduction 8-1
Control Input/Output 8-2
Parameter Lists 8-3

CHAPTER 9 — BAC PRESSURE PSIG/BAR APPLICATION (SVCHS301/SVCHS303) . . . 9-1
Introduction 9-1
Control Input/Output 9-2
Parameter Lists 9-3

CHAPTER 10 — REMOTE CONTROL APPLICATION (HVCHS0025) 10-1
Introduction 10-1
Control Input/Output 10-2
Parameter Lists 10-3

CHAPTER 11 — DESCRIPTION OF PARAMETERS 11-1
Parameters by ID Number 11-1
Keypad Control Parameters 11-45
Additional Information 11-46
Parameters of Motor Thermal Protection 11-46
Parameters of Stall Protection 11-47
Parameters of Underload Protection 11-47
Fieldbus Control Parameters 11-47

APPENDIX A — TECHNICAL DATA A-1
Specifications A-1
Power Ratings A-3
Power Loss and Switching Frequency A-4
Dimensions A-8
EMC Capability A-14
Declaration of Conformity A-14
Warranty and Liability Information A-14

APPENDIX B — FAULT AND WARNING CODES B-1

APPENDIX C — ACCESSORIES C-1
RS-232 Cables Used with BAC VFDs C-1

APPENDIX D — WIRING DIAGRAMS D-1

List of Figures

Figure 2-1: Mounting Space Requirements 2-1
Figure 3-1: Input Power and Motor Cable Stripping and Wire Lengths 3-4
Figure 3-2: Wiring Plate 3-5
Figure 3-3: Ground Terminal Locations 3-5
Figure 3-4: Cable Protection Plate 3-6
Figure 3-5: Principle Wiring Diagram of BAC VFD Power Unit, FR4, FR5 and FR6 3-7
Figure 3-6: Principle Wiring Diagram of BAC VFD Power Unit, FR7 and FR8 3-8
Figure 3-7: Principle Wiring Diagram of BAC VFD Power Unit, FR9 3-9
Figure 3-8: FR4 Power and Motor Wiring Terminals 3-10
Figure 3-9: FR5 Power and Motor Wiring Terminals 3-11
Figure 3-10: FR6 Power and Motor Wiring Terminals 3-12
Figure 3-11: FR7 Power and Motor Wiring Terminals 3-13
Figure 3-12: FR8 Power and Motor Wiring Terminals 3-14
Figure 3-13: FR9 Power and Motor Wiring Terminals 3-15
Figure 4-1: Option Board Slots 4-1
Figure 4-2: Option Board A9 Wiring Diagram 4-3
Figure 4-3: Option Board A9 Jumper Location and Settings 4-5
Figure 4-4: Option Board A2 Wiring Diagram 4-5
Figure 4-5: Option Board A2 Terminal Locations 4-6
Figure 4-6: Positive/Negative Logic 4-6
Figure 5-1: BAC TYPE 1 Bypass VFD Dimensions 5-2
Figure 5-2: BAC TYPE 12 Enclosed VFD Dimensions 5-3
Figure 5-3: BAC TYPE 3R Enclosed VFD Dimensions 5-4
Figure 5-4: Identification of TYPE 3R Components 5-5
Figure 5-5: Tools Required 5-5
Figure 5-6: Schematic for Static Checks 5-11
Figure 5-7: Identification of TYPE 1 Components 5-12
Figure 5-8: Bypass Power and Motor Terminal Wiring Example 5-17
Figure 5-9: Option Board B5 Wiring Diagram 5-18
Figure 5-10: Option Board B5 Terminal Location 5-19
Figure 5-11: Enable Bypass 5-19
Figure 6-1: Keypad and Display 6-1
Figure 6-2: Main Menu Navigation 6-5
Figure 6-3: Parameter Menu Structure Example 6-6
Figure 6-4: Keypad Control Menu 6-7
Figure 6-5: Active Fault Display Example 6-8
Figure 6-6: Sample Fault History Display 6-10
Figure 6-7: System Menu Structure 6-11
Figure 6-8: Expander Board Menu Structure 6-19
Figure 6-9: Digital Inputs — DIN1, DIN2, DIN3 Status 6-20
Figure 6-10: Digital Inputs — DIN4, DIN5, DIN6 Status 6-21
Figure 6-11: Digital and Relay Outputs — DO-1, RO-1, RO-2 Status 6-21
Figure 6-12: Operate Menu Navigation 6-22
Figure 7-1: Start-Up Wizard Navigation (1 of 3) 7-4
Figure 7-2: Start-Up Wizard Navigation (2 of 3) 7-5
Figure 7-3: Start-Up Wizard Navigation (3 of 3) 7-6
Figure 11-1: Linear and Squared V/Hz Ratio 11-2
Figure 11-2: Programmable V/Hz Curve 11-2

List of Figures, continued

Figure 11-3: PID Controller Function as I-Controller 11-4
Figure 11-4: PID Output Curve with the Values of Example 2 11-5
Figure 11-5: PID Output Curve with the Values of Example 3 11-6
Figure 11-6: DIN3 as DC-Brake Command Input 11-8
Figure 11-7: Analog Output Filtering 11-8
Figure 11-8: Analog Output Invert 11-9
Figure 11-9: Analog Output Scaling 11-10
Figure 11-10: Output Frequency Supervision 11-12
Figure 11-11: DC Braking Command (Selection 12) Selected for DIN2 11-13
Figure 11-12: AI-1 No Signal Inversion 11-14
Figure 11-13: AI-1 Signal Inversion 11-14
Figure 11-14: AI-1 No Signal Filtering 11-15
Figure 11-15: Analog Input AI-2 Scaling 11-15
Figure 11-16: Control Place B with and without Reference Scaling 11-17
Figure 11-17: External Brake Control 11-19
Figure 11-18: Acceleration/Deceleration (S-shaped) 11-20
Figure 11-19: DC-Braking Time when Stop Mode = Coasting 11-22
Figure 11-20: DC-Braking Time when Stop Mode = Ramp 11-23
Figure 11-21: Example of Skip Frequency Area Setting 11-23
Figure 11-22: Ramp Speed Scaling between Skip Frequencies 11-24
Figure 11-23: Motor Thermal Current IT Curve 11-28
Figure 11-24: Motor Thermal Protection 11-29
Figure 11-25: Stall Characteristics Settings 11-30
Figure 11-26: Stall Time Count 11-30
Figure 11-27: Setting of Minimum Load 11-31
Figure 11-28: Underload Time Counter Function 11-32
Figure 11-29: Example of Automatic Restarts with Two Restarts 11-33
Figure 11-30: Frequency Converter Sleep Function 11-39
Figure 11-31: Frequency Reference Logic of the Fire Mode PID Application When Running in Fire Mode 11-44
Figure A-1: Power Loss as Function of Switching Frequency: 1 – 3 hp 230V, 1-1/2 – 7-1/2 hp 480V A-5
Figure A-2: Power Loss as Function of Switching Frequency: 5 – 10 hp 230V, 10 – 20 hp 480V A-5
Figure A-3: Power Loss as Function of Switching Frequency: 15 and 20 hp 230V, 25 – 40 hp 480V A-6
Figure A-4: Power Loss as Function of Switching Frequency: 50 – 75 hp 480V A-6
Figure A-5: Power Loss as Function of Switching Frequency: 100 – 150 hp 480V A-7
Figure A-6: Power Loss as Function of Switching Frequency: 200 – 250 hp 480V A-7
Figure A-7: TYPE 1 and TYPE 12 BAC Open VFD Dimensions, FR4, FR5 and FR6 . . . . . A-8
Figure A-8: BAC Open VFD Dimensions, TYPE 1 and TYPE 12 with Flange Kit, FR4, FR5 and FR6 . . . . . A-9
Figure A-9: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR7 . . . . . A-10
Figure A-10: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR8 . . . . . A-11
Figure A-11: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, with Flange Kit, FR7 and FR8 . . . . . A-12
Figure A-12: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR9 . . . . . A-13
Figure C-1: RS-232 Cable for Parameter Setting or Software Downloading by Using PC C-1

List of Figures, continued

Figure C-2: Connection of Cable Used with Keypad C-1
Figure C-3: RS-232 Cable C-2
Figure D-1: VFD Wiring Diagram (Standard) D-1
Figure D-2: VFD Wiring Diagram with Enclosure Heater D-2
Figure D-3: VFD Wiring Diagram with Line Side Fuses D-3
Figure D-4: VFD Wiring Diagram with Enclosure Heater and Line Side Fuses D-4

List of Tables

Table 1-1: BAC VFD Catalog Numbering System 1-2
Table 1-2: Fusing Information 1-2
Table 2-1: Space Requirements for Mounting a BAC VFD — Type 1 Enclosure 2-1
Table 2-2: Cooling Airflow Requirements 2-2
Table 3-1: Cable Spacings 3-1
Table 3-2: Cable and Fuse Sizes, 208 – 240V Ratings 3-2
Table 3-3: Cable and Fuse Sizes, 380 – 500V Ratings 3-2
Table 3-4: Cable and Fuse Sizes, 525 – 690V Ratings 3-3
Table 3-5: Maximum Symmetrical Supply Current 3-3
Table 3-6: Power Connection Tightening Torque. 3-3
Table 3-7: Power and Motor Cable Stripping Lengths 3-4
Table 4-1: Tightening Torques of Terminals 4-2
Table 4-2: Control Wiring Instructions 4-2
Table 4-3: Option Board A9 Terminal Descriptions 4-4
Table 4-4: Option Board A2 Terminal Descriptions 4-6
Table 5-1: BAC VFD Catalog Numbering System 5-1
Table 5-2: BAC TYPE 1 Bypass VFD Information 5-2
Table 5-3: BAC TYPE 12 Enclosed Bypass VFD Dimensions. 5-3
Table 5-4: BAC TYPE 3R Enclosed Bypass VFD Dimensions 5-4
Table 5-5: Bypass Power Wiring Instructions — TYPE 3R and 12 5-6
Table 5-6: Static Checks of Converter 5-10
Table 5-7: Static Checks of Inverter. 5-10
Table 5-8: Static Checks of DC Bus 5-11
Table 5-9: Bypass Power Wiring Instructions — TYPE 1. 5-12
Table 5-10: Option Board B5 Terminal Descriptions 5-18
Table 6-1: LCD Status Indicators 6-2
Table 6-2: LED Status Indicators 6-2
Table 6-3: Navigation Buttons 6-3
Table 6-4: Fault Types 6-9
Table 6-5: Fault Time Data 6-9
Table 6-6: Total Counters 6-16
Table 6-7: Trip Counters 6-16
Table 6-8: Software Information 6-17
Table 6-9: Application Information 6-17
Table 6-10: Hardware Information 6-17
Table 6-11: Expander Board Information 6-18
Table 6-12: Power Monitor 6-18
Table 6-13: Power Multimonitor 6-18
Table 6-14: Monitoring Menu Items — Pressure Control Application Example 6-20
Table 6-15: Operate Menu Items — Temperature Control Application Example 6-21
Table 8-1: BAC Temp F/C Application Default I/O Configuration 8-2
Table 8-2: Basic Parameters — M1 ➔ G1.1 8-3
Table 8-3: Input Signals — M1 ➔ G1.2 8-5
Table 8-4: Output Signals — M1 ➔ G1.3 8-8
Table 8-5: Drive Control Parameters — M1 ➔ G1.4. 8-11

List of Tables, continued

Table 8-6: Skip Frequencies — M1 ➔ G1.5 8-12
Table 8-7: Motor Control Parameters — M1 ➔ G1.6 8-12
Table 8-8: Protections — M1 ➔ G1.7 8-13
Table 8-9: Auto Restart Parameters — M1 ➔ G1.8 8-15
Table 8-10: Fire Mode Parameters — M1 ➔ G1.9 8-16
Table 8-11: Preset Speed Parameters — M1 ➔ G1.10 8-16
Table 8-12: Binary Inputs for Preset Speeds 8-16
Table 8-13: PID-Control Parameters — M1 ➔ G1.11 8-17
Table 8-14: Fieldbus Parameters — M1 ➔ G1.12 8-19
Table 8-15: Keypad Control Parameters — M2 8-19
Table 8-16: Monitoring Menu 8-20
Table 9-1: BAC Pressure PSIG/Bar Application Default I/O Configuration 9-2
Table 9-2: Basic Parameters — M1 ➔ G1.1 9-3
Table 9-3: Input Signals — M1 ➔ G1.2 9-5
Table 9-4: Output Signals — M1 ➔ G1.3 9-8
Table 9-5: Drive Control Parameters — M1 ➔ G1.4 9-11
Table 9-6: Skip Frequencies — M1 ➔ G1.5 9-12
Table 9-7: Motor Control Parameters — M1 ➔ G1.6 9-12
Table 9-8: Protections — M1 ➔ G1.7 9-13
Table 9-9: Auto Restart Parameters — M1 ➔ G1.8 9-15
Table 9-10: Fire Mode Parameters — M1 ➔ G1.9 9-16
Table 9-11: Preset Speed Parameters — M1 ➔ G1.10 9-16
Table 9-12: Binary Inputs for Preset Speeds 9-16
Table 9-13: PID-Control Parameters — M1 ➔ G1.11 9-17
Table 9-14: Fieldbus Parameters — M1 ➔ G1.12 9-19
Table 9-15: Keypad Control Parameters — M2 9-19
Table 9-16: Monitoring Menu 9-20
Table 10-1: Remote Control Application Default I/O Configuration 10-2
Table 10-2: Basic Parameters — M1 ➔ G1.1 10-3
Table 10-3: Input Signals — M1 ➔ G1.2 10-5
Table 10-4: Output Signals — M1 ➔ G1.3 10-8
Table 10-5: Drive Control Parameters — M1 ➔ G1.4 10-11
Table 10-6: Skip Frequencies — M1 ➔ G1.5 10-12
Table 10-7: Motor Control Parameters — M1 ➔ G1.6 10-12
Table 10-8: Protections — M1 ➔ G1.7 10-13
Table 10-9: Auto Restart Parameters — M1 ➔ G1.8 10-15
Table 10-10: Fire Mode Parameters — M1 ➔ G1.9 10-16
Table 10-11: Preset Speed Parameters — M1 ➔ G1.10 10-16
Table 10-12: Binary Inputs for Preset Speeds 10-16
Table 10-13: Fieldbus Parameters — M1 ➔ G1.11 10-17
Table 10-14: Keypad Control Parameters — M2 10-17
Table 10-15: Monitoring Menu 10-18
Table 10-16: Operate Menu Items 10-19
Table 11-1: Selections for IDs 171 and 172 11-6
Table 11-2: Analog Output Scaling 11-9
Table 11-3: Output Signals Via DO-1 and Output Relays RO-1 and RO-2 11-11
Table 11-4: Size-Dependent Switching Frequencies 11-25
Table 11-5: Typical Monitored Items 11-37
Table 11-6: Selectable Wake-Up Functions 11-40
Table A-1: BAC VFD Specifications A-1
Table A-2: 230V VT Output Power Ratings A-3
Table A-3: 480V VT Output Power Ratings A-3
Table A-4: 575V VT Output Power Ratings A-4
Table A-5: BAC Open VFD Dimensions A-8

List of Tables, continued

Table A-6: Dimensions for BAC Open VFD, FR4, FR5 and FR6 with Flange Kit. A-9
Table A-7: Dimensions for the Flange Opening, FR4 to FR6. . . . . A-9
Table A-8: BAC Open VFD Dimensions, FR7 . . . . . A-10
Table A-9: BAC Open VFD Dimensions, FR8 . . . . . A-11
Table A-10: Dimensions for BAC Open VFD, FR7 and FR8 with Flange Kit A-12
Table A-11: Dimensions for the Flange Opening, FR7/FR8 . . . . . A-12
Table A-12: BAC Open VFD Dimensions, FR9 . . . . . A-13
Table B-1: Fault Codes B-1

Safety

Definitions and Symbols

⚠ WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: WARNING or CAUTION as described below.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the equipment. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

⚠ WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

- Stand on an insulating pad and make it a habit to use only one hand when checking components.
- Always work with another person in case an emergency occurs.
- Disconnect power before checking controllers or performing maintenance.
- Be sure equipment is properly grounded.
- Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings, Cautions and Notices

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up or operate this BAC VFD.

Warnings

⚠ WARNING

Be sure to ground the unit following the instructions in this manual. Ungrounded units may cause electric shock and/or fire.

⚠ WARNING

This equipment should be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of this type of equipment and the hazards involved. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

Components within the BAC power unit are live when the drive is connected to power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

Line terminals (L1, L2, L3), motor terminals (U, V, W) and the DC-link/brake resistor terminals (-/+) are live when the drive is connected to power, even if the motor is not running. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

Even though the control I/O-terminals are isolated from line voltage, the relay outputs and other I/O-terminals may have dangerous voltage present even when the drive is disconnected from power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

The BAC VFD has a large capacitive leakage current during operation, which can cause enclosure parts to be above ground potential. Proper grounding, as described in this manual, is required. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

Before applying power to the BAC VFD, make sure that the front and cable covers are closed and fastened to prevent exposure to potential electrical fault conditions. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

An upstream disconnect/protective device must be provided as required by the National Electric Code (NEC). Failure to follow this precaution may result in death or severe injury.

⚠ WARNING

Before opening the BAC VFD covers:

- Disconnect all power to the BAC VFD.
- Wait a minimum of 5 (five) minutes after all the lights on the keypad are off. This allows time for the DC bus capacitors to discharge.
- A hazardous voltage may still remain in the DC bus capacitors even if the power has been turned off. Confirm that the capacitors have fully discharged by measuring their voltage using a multimeter set to measure DC voltage.

Failure to follow the above precautions may cause death or severe injury.

⚠ WARNING

The BAC VFD's drives output terminals U, V and W correspond to a phase rotation of ABC. If the input terminals L1, L2 and L3 have not been wired for ABC, the motor rotation will be different when powered from the bypass instead of the BAC VFD which can result in personal injury and equipment damage. In this situation the input line wiring must be changed to correspond to ABC rotation.

Cautions

⚠ CAUTION

Do not perform any Megger or voltage withstand tests on any part of the BAC VFD or its components. Improper testing may result in damage.

⚠ CAUTION

Prior to any tests or measurements of the motor or the motor cable, disconnect the motor cable at the BAC VFD's output terminals (U, V, W) to avoid damaging the BAC VFD during the motor or cable testing.

⚠ CAUTION

Do not touch any components on the circuit boards. Static voltage discharge may damage the components.

⚠ CAUTION

Any electrical or mechanical modification to this equipment without prior written consent of Baltimore Aircoil Company will void all warranties and may result in a safety hazard in addition and voiding of the UL listing.

⚠ CAUTION

Install the BAC VFD on flame-resistant material such as a steel plate to reduce the risk of fire.

⚠ CAUTION

Install the BAC VFD on a perpendicular surface that is able to support the weight of the drive and is not subject to vibration, to lessen the risk of the drive falling and being damaged and/or causing personal injury.

⚠ CAUTION

Prevent foreign material such as wire clippings or metal shavings from entering the drive enclosure, as this may cause arcing damage and fire.

⚠ CAUTION

Install the BAC VFD in a well-ventilated room that is not subject to temperature extremes, high humidity, or condensation, and avoid locations that are directly exposed to sunlight, or have high concentrations of dust, corrosive gas, explosive gas, inflammable gas, grinding fluid mist, etc. Improper installation may result in a fire hazard.

Notice

Notice

Do not discard the plastic bag shipped with the drive containing the wiring plate.

Motor and Equipment Safety

⚠ CAUTION

Before starting the motor, check that the motor is mounted properly and aligned with the driven equipment. Ensure that starting the motor will not cause personal injury or damage equipment connected to the motor.

⚠ CAUTION

Set the maximum motor speed (frequency) in the BAC VFD according to the requirements of the motor and the equipment connected to it. Incorrect maximum frequency settings can cause motor or equipment damage and the potential for personal injury.

⚠ CAUTION

Before reversing the motor rotation, ensure that this will not cause personal injury or equipment damage.

⚠ CAUTION

Make sure that no power factor correction capacitors are connected to the BAC VFD's output or the motor terminals to prevent BAC VFD malfunction and potential damage.

⚠ CAUTION

Make sure that the BAC VFD's output terminals (U, V, W) are not connected to the utility line power as severe damage to the BAC VFD and personal injury may occur.

August 2006

Chapter 1 — Overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the BAC VFD catalog numbering system.

How to Use This Manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the BAC VFD. To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the BAC VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Chapter 1 – Overview

Chapter 2 – Mounting

Chapter 3 – Power Wiring

Chapter 4 – Control Wiring

Chapter 5 – Bypass Feature

Chapter 6 – Menu Information

Chapter 7 – Start-Up

Chapter 8 to 10 – Applications

Chapter 11 – Description of Parameters

Appendix A – Technical Data

Appendix B – Fault and Warning Codes

Appendix C – Accessories

Appendix D – Wiring Diagrams

Receiving and Inspection

The BAC VFD has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your BAC VFD, please do the following:

- Make sure that the package(s) includes the BAC VFD, the User Manual, rubber conduit covers, screws, conduit plate and ground straps.
- Inspect the unit to ensure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the Catalog Number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately. If the delivery does not correspond to your order, please contact your Baltimore Aircoil Company representative.

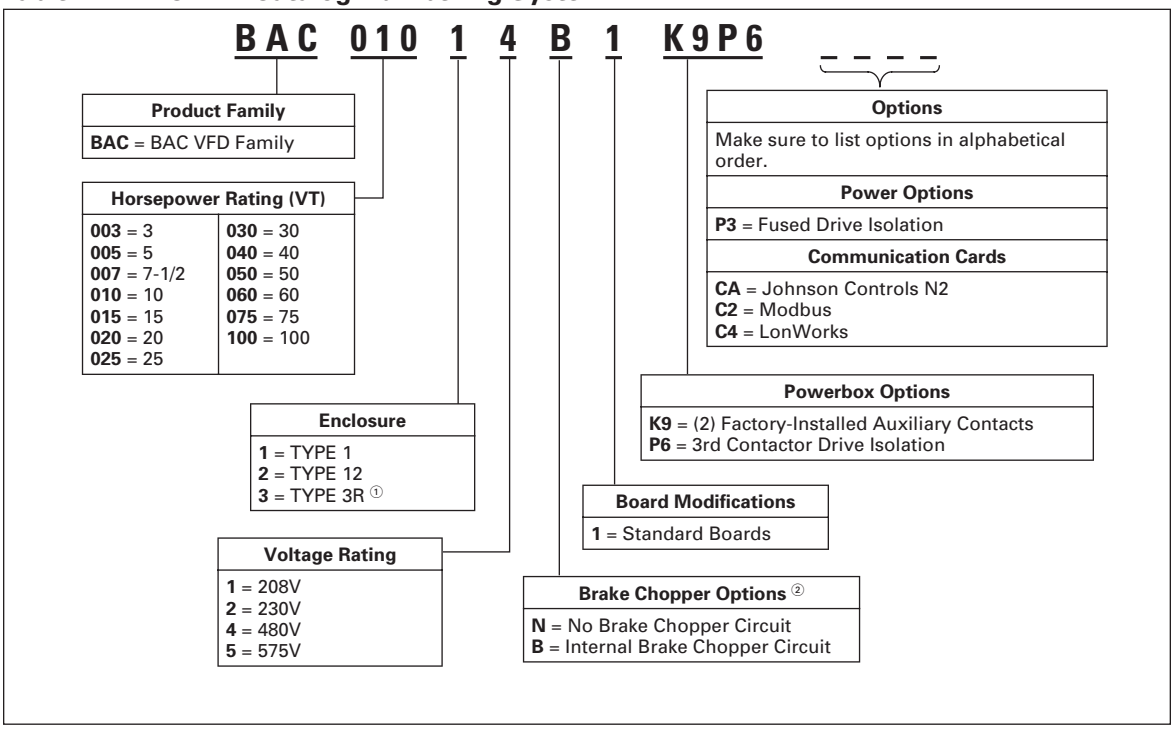
Note: The template printed on the protective cardboard can be used for marking the mounting points of the BAC VFD on the wall or cabinet.

Notice

Do not discard the plastic bag shipped with the drive containing the wiring plate.

Catalog Numbering System

Table 1-1: BAC VFD Catalog Numbering System



① Space heater is included in TYPE 3R enclosure.

② 480V Drives up to 40 hp (VT) are only available with Brake Chopper Option **B**.
480V Drives 50 hp (VT) or larger are only available with Brake Chopper Option **N**.
230V Drives up to 20 hp (VT) are only available with Brake Chopper Option **B**.
575V Drives are standard without Brake Chopper Option **N**.

Note: Availability —
208V: 3 – 60 hp, 230V: 3 – 75 hp, 480V: 3 – 150 hp, 575V: 3 – 100 hp

Table 1-2: Fusing Information

Voltage Rating	hp Range	TYPE 1	TYPE 12	TYPE 3R
208 / 230V	1 – 20	X	X	X
480V	1 – 40	X	X	X
575V	1 – 50		X	X

Chapter 2 — Mounting Open TYPE 1, TYPE 12 Drives

The BAC VFD open drives may be mounted side-by-side or stacked vertically, as outlined in the following section.

See **Chapter 5** for mounting TYPE 1, TYPE 12 and TYPE 3R IntelliPass drives.

Space Requirements

To ensure proper air circulation and cooling, follow the guidelines below.

Table 2-1: Space Requirements for Mounting a BAC VFD — Type 1 Enclosure

Drive Type Variable Torque Rating	Approximate Dimensions in Inches (mm) ①				
	A	A_2	B	C	D
230V, 1 – 3 hp 480V, 1-1/2 – 7-1/2 hp	0.8 (20)		0.8 (20)	3.9 (100)	2.0 (50)
230V, 5 – 10 hp 480V, 10 – 20 hp	0.8 (20)		0.8 (20)	4.7 (120)	2.4 (60)
230V, 15 – 20 hp 480V, 25 – 40 hp 575V, 3 – 30 hp	1.2 (30)		0.8 (20)	6.3 (160)	3.1 (80)
230V, 25 – 40 hp 480V, 50 – 75 hp 575V, 40 – 50 hp	3.1 (80)		3.1 (80)	11.8 (300)	3.9 (100)
230V, 50 – 75 hp 480V, 100 – 150 hp 575V, 60 – 100 hp	3.1 (80)	5.9 (150)	3.1 (80)	11.8 (300)	7.9 (200)
230V, 100hp 480V, 200 – 250 hp 575V, 125 – 200 hp	2.0 (50)		3.1 (80)	15.7 (400)	9.8 (250) 13.8 ② (350)

① Dimensions represent the minimum clearance needed when mounting a drive. See **Figure 2-1** below.
A = Clearance around the BAC VFD.
A_2 = Clearance needed to change the fan without disconnecting the motor cables.
B = Distance between adjacent BAC VFD or between the BAC VFD and an enclosure wall.
C = Clearance above the BAC VFD.
D = Clearance below the BAC VFD.
② Minimum clearance below the BAC VFD needed to change the fan.

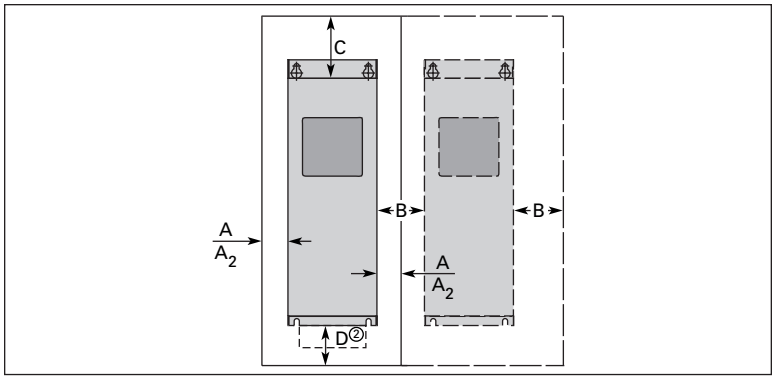


Figure 2-1: Mounting Space Requirements

If several units are mounted above each other, the clearance between the drives should equal C + D (see **Table 2-1** and **Figure 2-1** above). In addition, the outlet air used for cooling the lower unit must be directed away from the inlet air used by the upper unit.

Environmental Requirements

Ensure that the environment meets the requirements listed in **Table A-1** of **Appendix A** for any storage or operating situation.

The following table specifies the minimum airflow required in the area where the drive will be mounted.

Table 2-2: Cooling Airflow Requirements

Drive Type **Variable Torque Ratings**	**Cooling Air Required**
230V, 1 – 3 hp 480V, 1-1/2 – 7-1/2 hp	41 cfm (70 m^3/h)
230V, 5 – 10 hp 480V, 10 – 20 hp	112 cfm (190 m^3/h)
230V, 15 – 20 hp 480V, 25 – 40 hp 575V, 3 – 30 hp	250 cfm (425 m^3/h)
230V, 25 – 40 hp 480V, 50 – 75 hp 575V, 40 – 50 hp	250 cfm (425 m^3/h)
230V, 50 – 75 hp 480V, 100 – 150 hp 575V, 60 – 100 hp	383 cfm (650 m^3/h)
480V, 200 – 250 hp 575V, 125 – 200 hp	765 cfm (1300 m^3/h)

Standard Mounting Instructions

1. Measure the mounting space to ensure that it allows for the minimum space surrounding the BAC VFD. Drive dimensions are in **Appendix A**.
2. Make sure the mounting surface is flat and strong enough to support the drive, and it is not flammable or subject to excessive motion or vibration.
3. Ensure that the minimum airflow requirements for your drive are met at the mounting location.
4. Mark the location of the mounting holes on the mounting surface, using the template provided on the cover of the cardboard shipping package.
5. Using fasteners appropriate to your drive and mounting surface, securely attach the drive to the mounting surface with all 4 screws or bolts.

Chapter 3 — Power Wiring (Open Drives)

Guidelines

To ensure proper wiring, follow these guidelines:

- Use heat-resistant copper cables only, +75°C or higher.
- Make sure the input line cable and line fuses are sized in accordance with the rated input current of the unit. See **Tables 3-2** and **3-5**.
- For maximum protection of the BAC VFD, use UL-recognized, type RK fuses that are consistent with UL listing requirements.
- If motor temperature sensing is used for overload protection, select the output wire size based on the motor specifications.
- If three or more shielded cables are used in parallel for the output on the larger units, make sure every cable has its own overload protection.
- Avoid placing the motor cables in long parallel lines with other cables.
- If the motor cables run in parallel with other cables, note the minimum distances between the motor cables and other cables given in **Table 3-1** below.

Table 3-1: Cable Spacings

Minimum Distance Between Cables in Feet (m)	Shielded Cable Length in Feet (m)
1 (0.3)	≤164 (50)
3.3 (1.0)	≤656 (200)

Note: The measurements in **Table 3-1** also apply to the spacing between the motor cables and signal cables of other systems.

- Make sure the maximum length of the inverter rated cable is as follows:
  - Filters are not needed on 208/230V units; filters required **on lead length ≥175 ft**., 480 and 575V AC drives.

    Note: Lead lengths ≥500 ft. require sine wave filter for all voltages.
- Make sure motor cables cross other cables at an angle of 90 degrees.
- If conduit is used for wiring, use separate conduits for the input power wiring, output power wiring, signal wiring and control wiring.

UL Compatible Cable Selection and Installation

Use only copper wire with a temperature rating of at least 167°F (75°C).

Table 3-2: Cable and Fuse Sizes, 208 – 240V Ratings ②

hp	Frame Size	NEC I_I (A)	I_I (A)	Fuse (A) ①③	Wire Size		Terminal Size	
					Power	Ground	Power	Ground
1	FR4	4.2	4.8	10	14	14	16 – 12	16 – 14
1-1/2	FR4	6	6.6	10	14	14	16 – 12	16 – 14
2	FR4	6.8	7.8	10	14	14	16 – 12	16 – 14
3	FR4	9.6	11	15	14	14	16 – 12	16 – 14
5	FR5	15.2	17.5	20	12	12	16 – 8	16 – 8
7-1/2	FR5	22	25	30	10	10	16 – 8	16 – 8
10	FR5	28	31	40	8	8	16 – 8	16 – 8
15	FR6	42	48	60	4	8	14 – 0	10 – 2
20	FR6	54	61	80	2	6	14 – 0	10 – 2
25	FR7	68	75	100	2	6	14 – 0	10 – 00
30	FR7	80	88	110	1	6	14 – 0	10 – 00
40	FR7	104	114	125	1/0	4	14 – 0	10 – 00
50	FR8	130	140	175	3/0	2	4-3/0	4-000
60	FR8	154	170	200	4/0	0	000-350 MCM	4-000
75	FR8	192	205	250	300	2/0	000-350 MCM	4-000
100	FR9	248	261	300	2 x 4/0	3/0	2*000-350 MCM	4-000

① If power cubes are used, a UL recognized RK fuse is recommended.
② Based on maximum environment of 104°F (40°C).
③ If bypass is used, a UL recognized RK5 fuse is recommended.

Table 3-3: Cable and Fuse Sizes, 380 – 500V Ratings ⑤

hp	Frame Size	NEC I_I (A)	I_I (A)	Fuse (A) ④⑥	Wire Size		Terminal Size	
					Power	Ground	Power	Ground
1-1/2	FR4	3	3.3	10	14	14	16 – 12	16 – 14
2	FR4	3.4	4.3	10	14	14	16 – 12	16 – 14
3	FR4	4.8	5.6	10	14	14	16 – 12	16 – 14
5	FR4	7.6	7.6	10	14	14	16 – 12	16 – 14
7-1/2	FR4	11	12	15	12	14	16 – 12	16 – 14
10	FR5	14	16	20	10	12	16 – 8	16 – 8
15	FR5	21	23	30	10	10	16 – 8	16 – 8
20	FR5	27	31	35	8	8	16 – 8	16 – 8
25	FR6	34	38	50	6	8	14 – 0	10 – 2
30	FR6	40	46	60	4	8	14 – 0	10 – 2
40	FR6	52	61	80	2	6	14 – 0	10 – 2
50	FR7	65	72	100	2	6	14 – 0	10 – 00
60	FR7	77	87	110	1	6	14 – 0	10 – 00
75	FR7	96	105	125	1/0	4	14 – 0	10 – 00
100	FR8	124	140	175	3/0	2	4 – 3/0	4 – 000
125	FR8	156	170	200	4/0	0	000 – 350 MCM	4 – 000
150	FR8	180	205	250	300	2/0	000 – 350 MCM	4 – 000
200	FR9	240	261	350	350	3/0	2*000 – 350 MCM	4 – 000
250	FR9	302	300	400	2 X 250	300	2*000 – 350 MCM	4 – 000

④ If power cubes are used, a UL recognized RK fuse is recommended.
⑤ Based on maximum environment of 104°F (40°C).
⑥ If bypass is used, a UL recognized RK5 fuse is recommended.

Table 3-4: Cable and Fuse Sizes, 525 – 690V Ratings ②

hp	Frame Size	I_I (A)	Fuse (A) ①③	Wire Size		Terminal Size	
				Power	Ground	Power	Ground
3	FR6	4.5	10	14	14	14 – 0	14 – 2
5	FR6	7.5	10	14	14	14 – 0	14 – 2
7-1/2	FR6	10	10	14	14	14 – 0	14 – 2
10	FR6	13.5	15	12	14	14 – 0	14 – 2
15	FR6	18	20	10	12	14 – 0	14 – 2
20	FR6	22	30	10	10	14 – 0	14 – 2
25	FR6	27	35	8	8	14 – 0	14 – 2
30	FR6	34	40	8	8	14 – 0	14 – 2
45	FR7	41	50	6	8	14 – 0	10 – 0
50	FR7	52	60	4	6	14 – 0	10 – 0
60	FR8	62	80	2	6	4 – 3/0	4 – 3/0
75	FR8	80	100	1	6	4 – 3/0	4 – 3/0
100	FR8	100	125	1/0	6	4 – 3/0	4 – 3/0
125	FR9	125	175	3/0	6	4 – 3/0	4 – 3/0
150	FR9	144	200	4/0	2	2x3/0 – 350 MCM	4 – 3/0
200	FR9	208	250	350	1/0	2x3/0 – 350 MCM	4 – 3/0

① If power cubes are used, a UL recognized RK fuse is recommended.
② Based on maximum environment of 104°F (40°C).
③ If bypass is used, a UL recognized RK5 fuse is recommended.

Table 3-5: Maximum Symmetrical Supply Current

Product	Voltage	Maximum RMS Symmetrical Amperes on Supply Circuit
1 – 75 hp	230	100,000A
1-1/2 – 250 hp	480	100,000A
3 – 200 hp	575	100,000A

Table 3-6: Power Connection Tightening Torque

Rating	Frame Size	Tightening Torque (in-lbs)	Tightening Torque (Nm)
230V, 1 – 3 hp 480V, 1-1/2 – 7-1/2 hp	FR4	5	0.6
230V, 5 – 10 hp 480V, 10 – 20 hp	FR5	13	1.5
230V, 15 and 20 hp 480V, 25 – 40 hp 575V, 3 – 30 hp	FR6	35	4
230V, 25 – 40 hp 480V, 50 – 75 hp 575V, 40 – 50 hp	FR7	88	10
230V, 50 – 75 hp 480V, 100 hp	FR8	170/80 ④	20/9 ④
480V, 125 – 150 hp 575V, 60 – 100 hp	FR8	354/195 ④	40/22 ④
480V, 200 – 250 hp 575V, 125 – 200 hp	FR9	354/195 ④	40/22 ④

④ The isolation standoff of the bus bar will not withstand the listed tightening torque. Use a wrench to apply a counter torque when tightening.

Installation Instructions

1. Strip the motor and power cables as shown in **Figure 3-1** and **Table 3-7**.

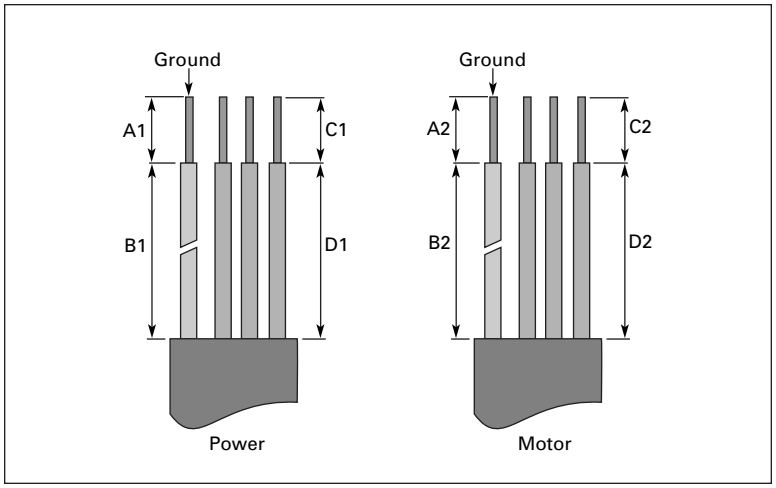


Figure 3-1: Input Power and Motor Cable Stripping and Wire Lengths

Table 3-7: Power and Motor Cable Stripping Lengths

Product		Frame Size	Power Wiring in Inches (mm)				Motor Wiring in Inches (mm)			
Horsepower	Voltage		A1	B1	C1	D1	A2	B2	C2	D2
1 – 3 1-1/2 – 7-1/2	230 480	FR4	0.59 (15)	1.38 (35)	0.39 (10)	0.79 (20)	0.28 (7)	1.97 (50)	0.28 (7)	1.38 (35)
5 – 10 10 – 20	230 480	FR5	0.79 (20)	1.57 (40)	0.39 (10)	1.18 (30)	0.79 (20)	2.36 (60)	0.39 (10)	1.57 (40)
15 and 20 25 – 40 3 – 30	230 480 575	FR6	0.79 (20)	3.54 (90)	0.59 (15)	2.36 (60)	0.79 (20)	3.54 (90)	0.59 (15)	2.36 (60)
25 – 40 50 – 75 40 – 50	230 480 575	FR7	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)
50 – 75 100 – 150 60 – 100	230 480 575	FR8	1.1 (28)	9.45 (240)	1.1 (28)	9.45 (240)	1.1 (28)	9.45 (240)	1.1 (28)	9.45 (240)
200 – 250 125 – 200	480 575	FR9	1.1 (28)	11.61 (295)	1.1 (28)	11.61 (295)	1.1 (28)	11.61 (295)	1.1 (28)	11.61 (295)

Notice

Do not discard the plastic bag containing the wiring plate.

2. Locate the plastic bag shipped with the drive containing the wiring plate, and remove the wiring plate.

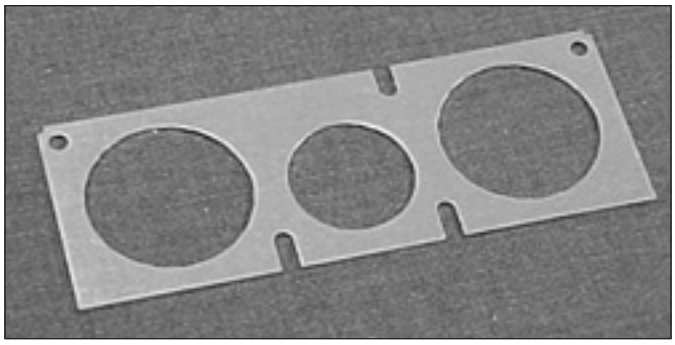


Figure 3-2: Wiring Plate

3. If conduit is being used, attach the wiring plate to it.
4. Feed the motor and input power wires/cables through the holes of the wiring plate.
5. Connect the input power and motor wires to their respective terminals according to the wiring diagrams in the "Standard Wiring Diagrams and Terminal Locations" section on **Page 3-7**.
6. If an optional external brake resistor is used, connect its cable to the appropriate terminals. See "Standard Wiring Diagrams and Terminal Locations" section on **Page 3-7**.
7. If shielded cable is used, connect the shields of the input line power cable and the motor cable to the motor and power ground terminals of the BAC VFD.

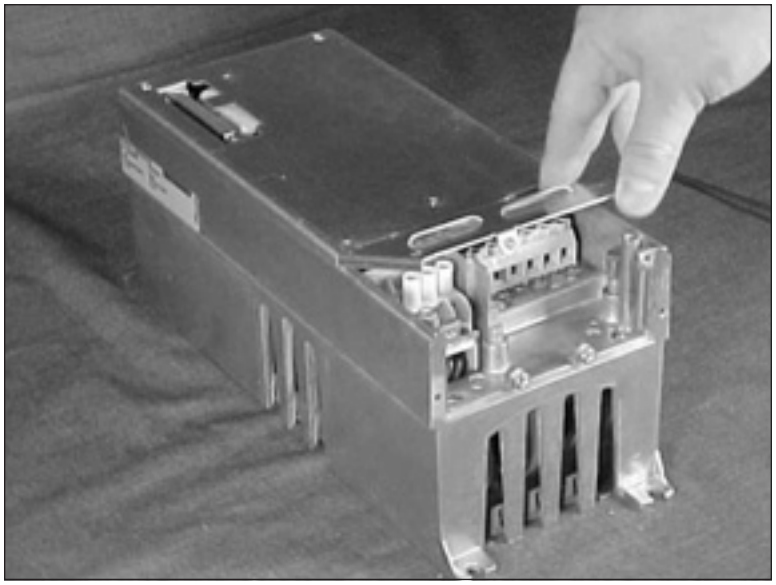


Figure 3-3: Ground Terminal Locations

8. If shielded cable is not used, check the connection of the ground cable to the motor and the BAC VFD and the input line power terminals marked with ⏚ .
9. Attach the wiring plate with the screws provided. Ensure that no wires are trapped between the frame and the wiring plate.
10. Insert the rubber grommets into the unused wiring plate holes as illustrated in **Figure 3-4**.

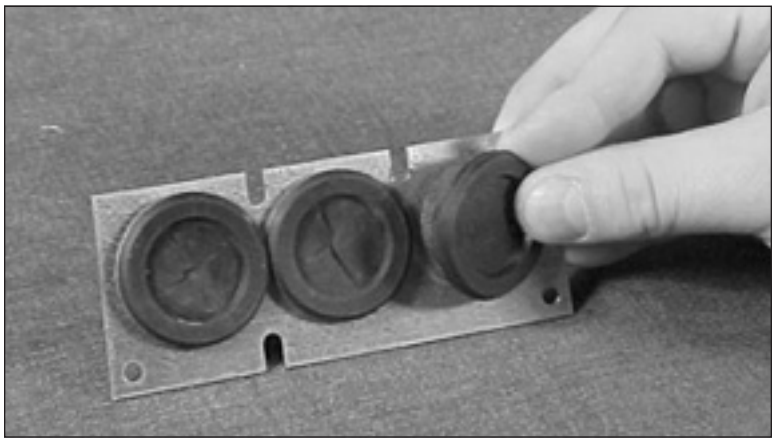


Figure 3-4: Cable Protection Plate

Notice

Do not discard the plastic bag containing the wiring plate.

Standard Wiring Diagrams and Terminal Locations

Power and Motor Wiring Terminal Schematics for BAC VFD

The following wiring diagrams show the line and motor connections of the drive.

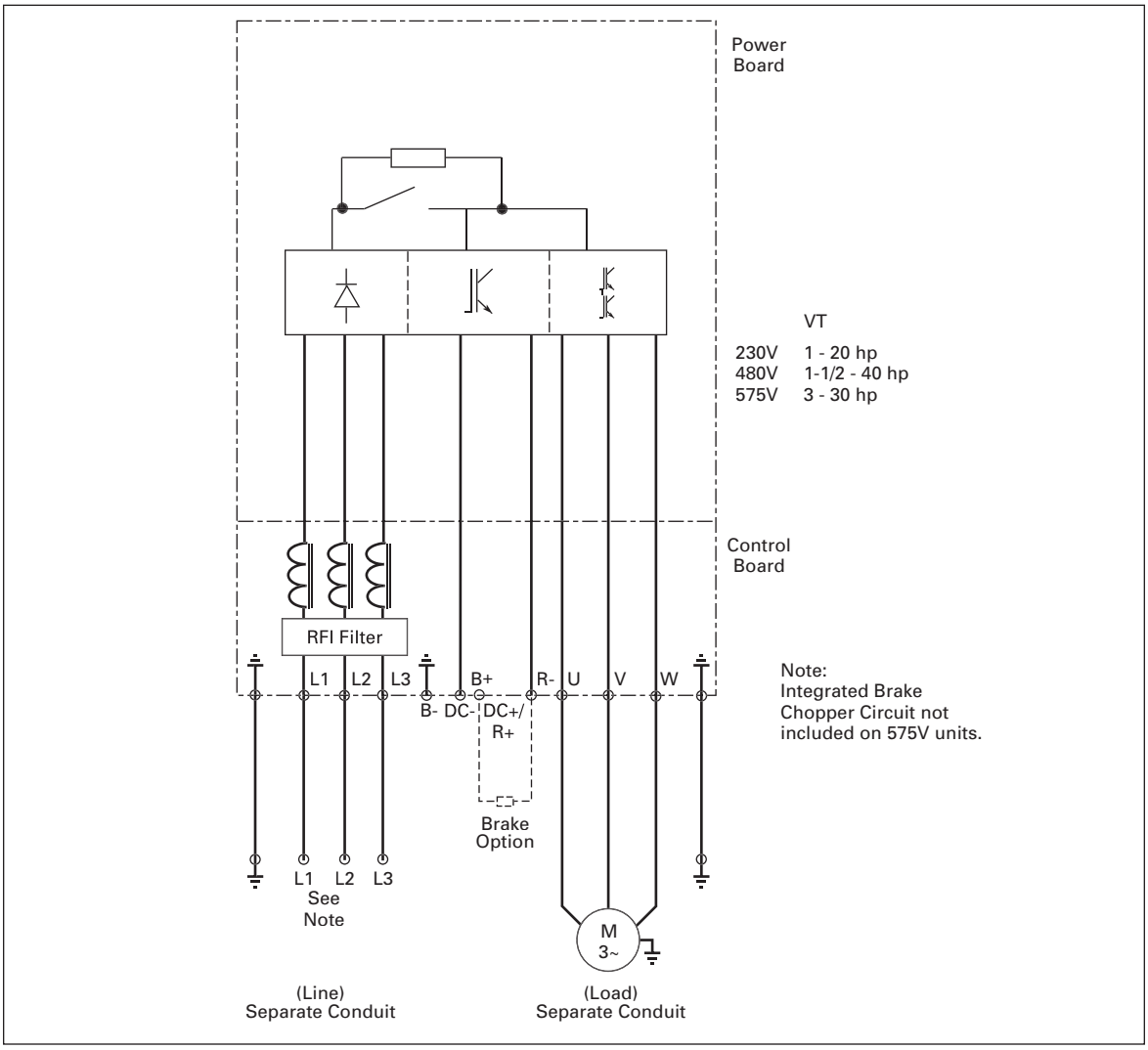


Figure 3-5: Principle Wiring Diagram of BAC VFD Power Unit, FR4, FR5 and FR6

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Refer to **Tables A-2** and **A-3** in **Appendix A**.

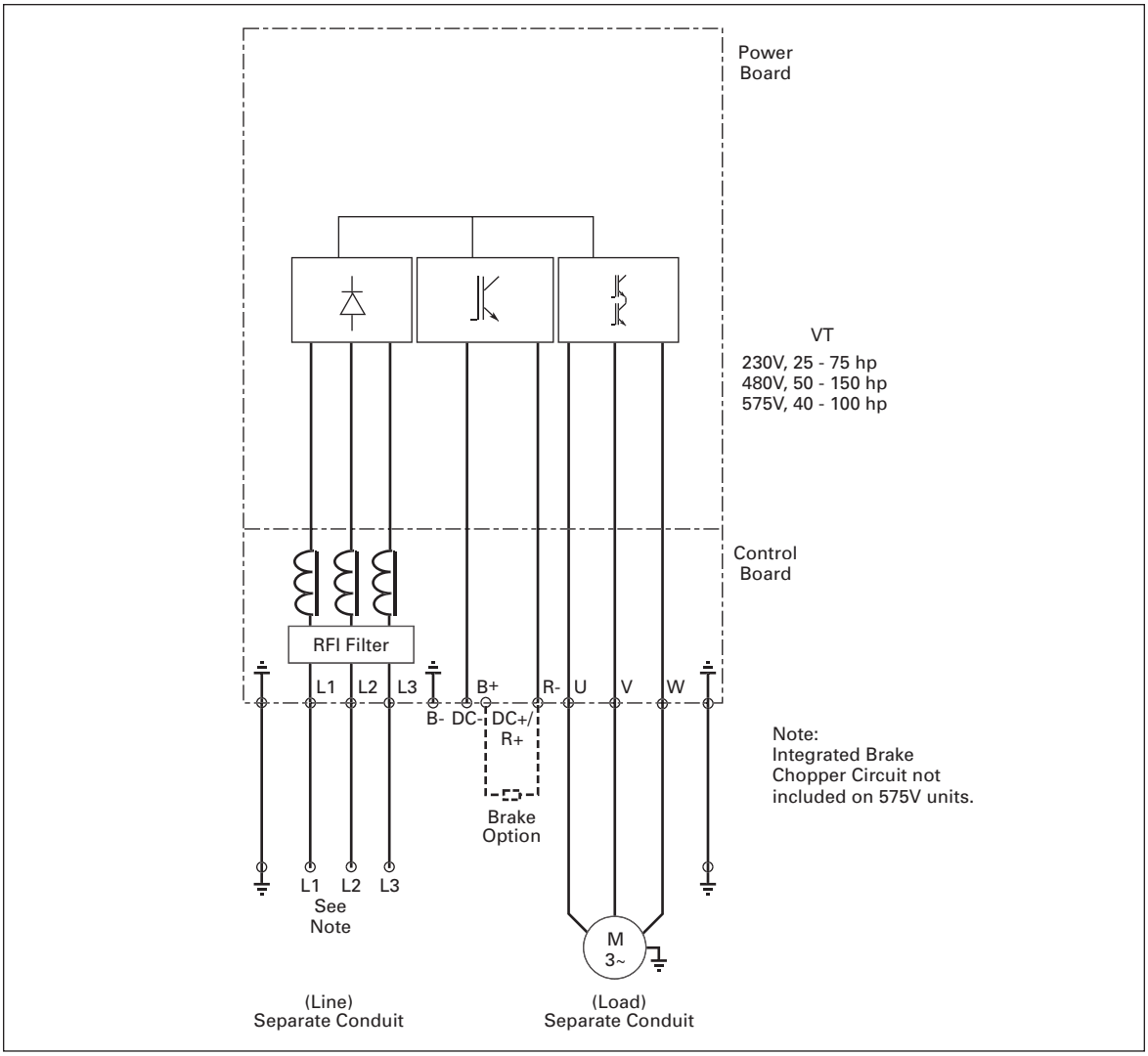


Figure 3-6: Principle Wiring Diagram of BAC VFD Power Unit, FR7 and FR8

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Refer to **Tables A-2** and **A-3** in **Appendix A**.

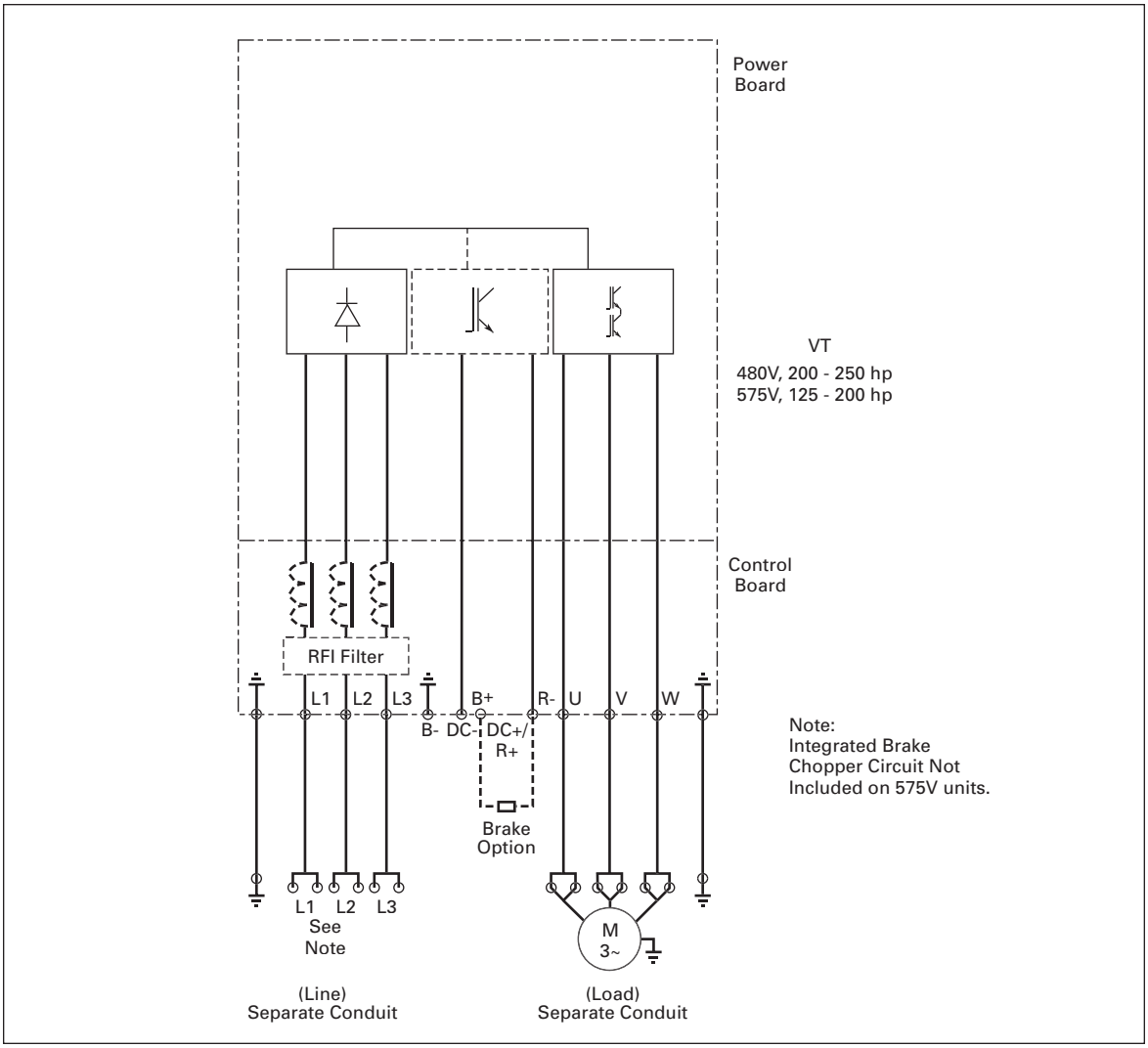


Figure 3-7: Principle Wiring Diagram of BAC VFD Power Unit, FR9

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Refer to **Table A-3** in **Appendix A**.

Power and Motor Wiring Terminal Photos

230V, 1 – 3 hp
480V, 1-1/2 – 7-1/2 hp

Frame Size: FR4

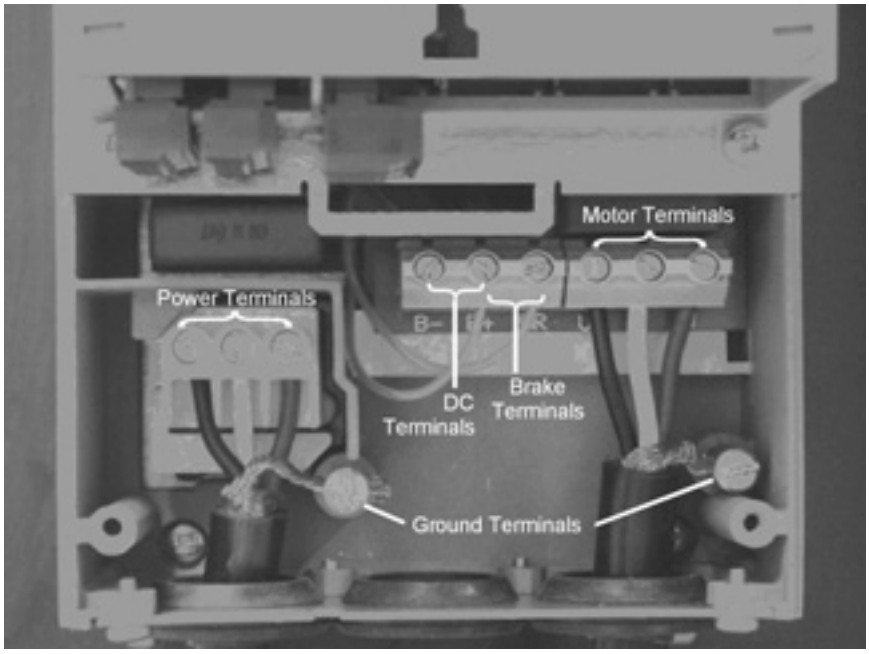


Figure 3-8: FR4 Power and Motor Wiring Terminals

230V, 5 – 10 hp
480V, 10 – 20 hp

Frame Size: FR5

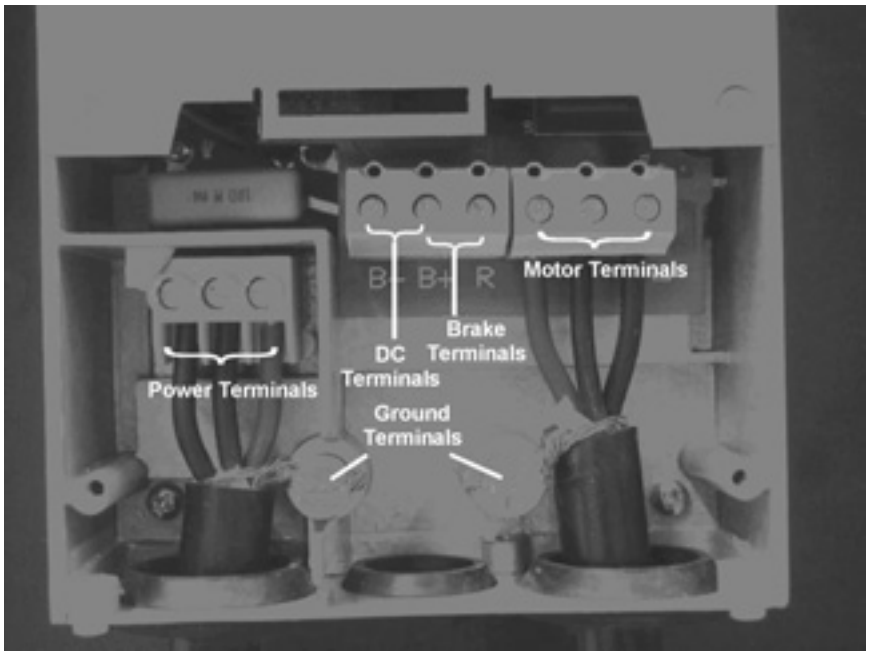


Figure 3-9: FR5 Power and Motor Wiring Terminals

230V, 15 – 20 hp
480V, 25 – 40 hp
575V, 3 – 30 hp
Frame Size: FR6

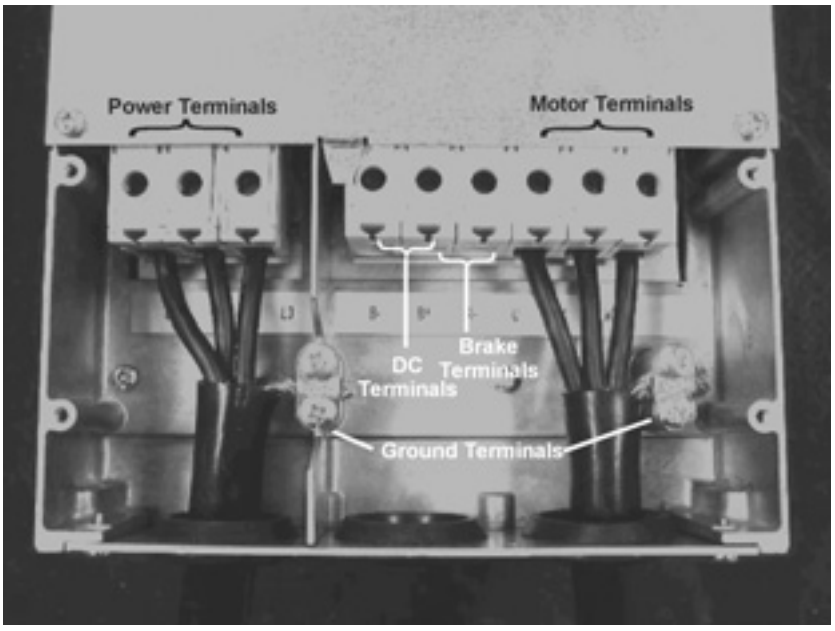


Figure 3-10: FR6 Power and Motor Wiring Terminals

230V, 25 – 40 hp
480V, 50 – 75 hp
575V, 40 – 50 hp
Frame Size: FR7

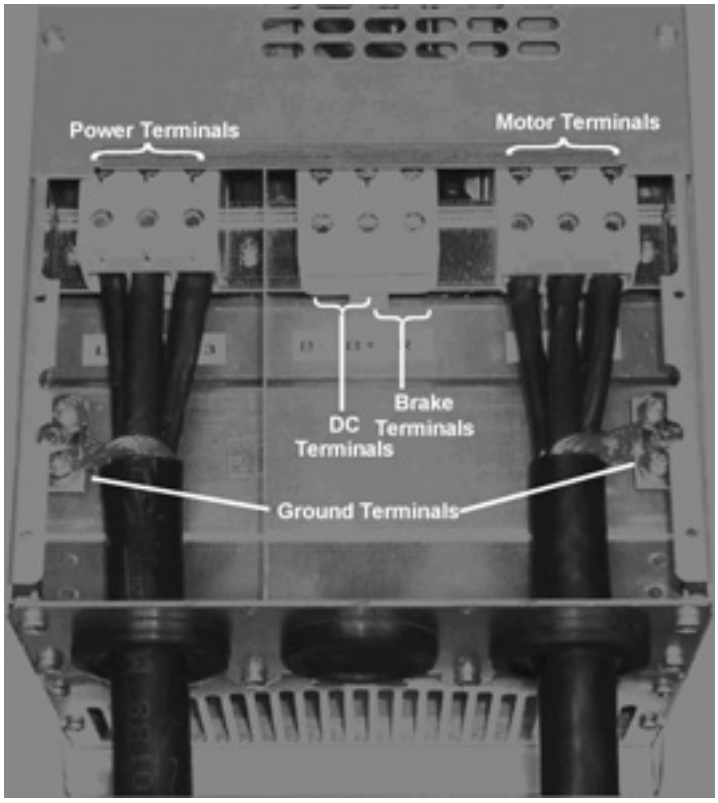


Figure 3-11: FR7 Power and Motor Wiring Terminals

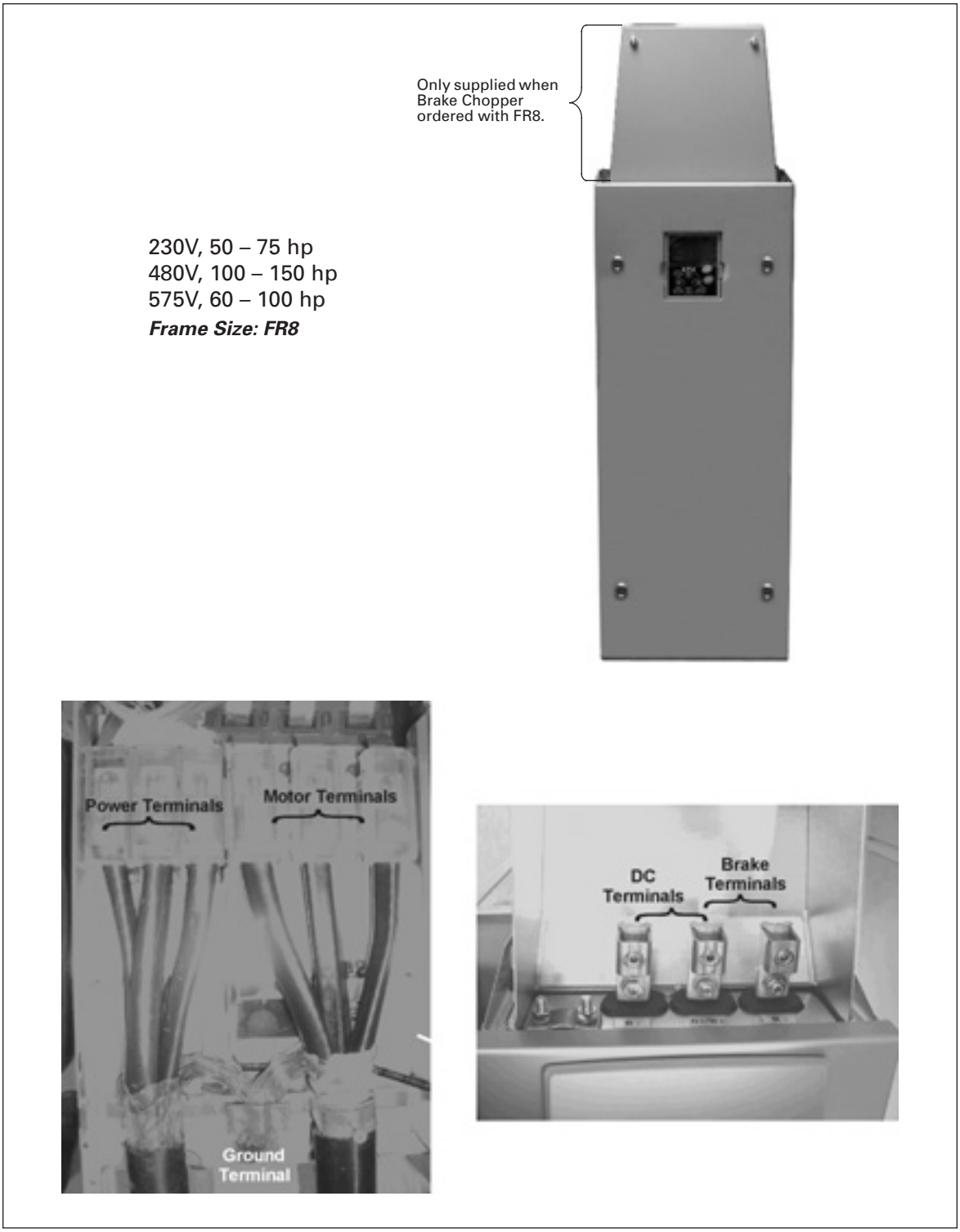


Figure 3-12: FR8 Power and Motor Wiring Terminals

480V, 200 – 250 hp
575V, 125 – 200 hp
Frame Size: FR9

Figure 3-13: FR9 Power and Motor Wiring Terminals

Checking the Cable and Motor Insulation

1. Check the motor cable insulation as follows:
   - Disconnect the motor cable from terminals U, V and W of the BAC VFD and from the motor.
   - Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor.
   - Make sure the insulation resistance is >1MΩ.
2. Check the input power cable insulation as follows:
   - Disconnect the input power cable from terminals L1, L2 and L3 of the BAC VFD and from the utility line feeder.
   - Measure the insulation resistance of the input power cable between each phase conductor as well as between each phase conductor and the protective ground conductor.
   - Make sure the insulation resistance is >1MΩ.
3. Check the motor insulation as follows:
   - Disconnect the motor cable from the motor and open any bridging connections in the motor connection box.
   - Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000V.
   - Make sure the insulation resistance is >1MΩ.

August 2006

Chapter 4 — Control Wiring

General Information

The control unit of the BAC VFD consists of the control board and various option boards that plug into the five slot connectors (A through E) of the control board.

Galvanic isolation of the control terminals is provided as follows:

- Control connections are isolated from power, and the GND terminals are permanently connected to ground.
- Digital inputs are galvanically isolated from the I/O ground.
- Relay outputs are double isolated from each other at 300V AC.

Option Board General Information (If Bypass Is Provided)

The BAC VFD can accommodate a wide selection of *expander* and *adapter boards* to customize the drive for your application needs.

The drive's control unit is designed to accept a total of five option boards. Option boards are available for normal analog and digital inputs and outputs, communication and additional application-specific hardware.

The BAC VFD factory-installed standard option board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B. For information on additional option boards, see the option board manuals.

Note: Your BAC VFD has been shipped with a factory-installed Bypass and the B5 option board installed in slot C.

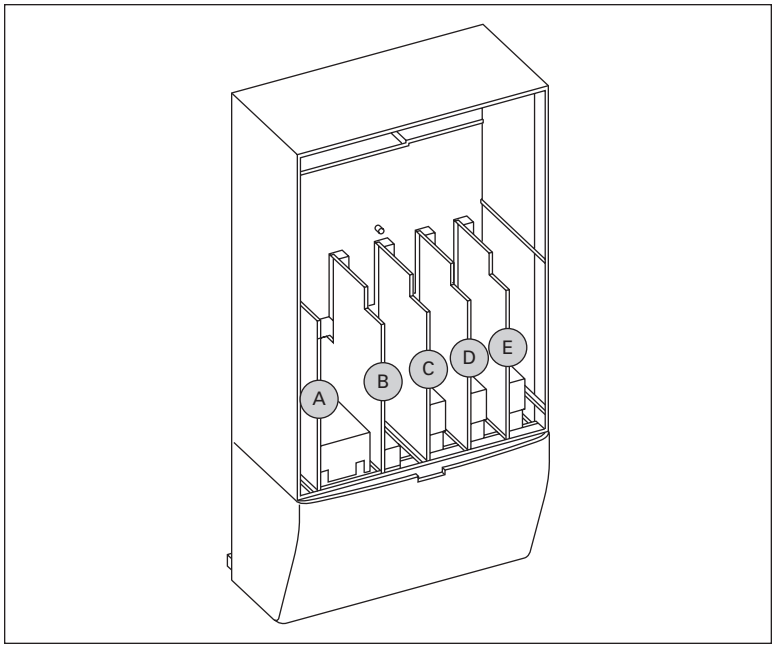


Figure 4-1: Option Board Slots

Control Wiring Guidelines

Wire the control terminals using the following guidelines:

- The control wires shall be at least AWG 20 (0.5 mm^2) shielded cables.
- The maximum wire size is AWG 14 (2.5 mm^2) for the relay terminals (Boards A9 and B5) and AWG 16 (1.5 mm^2) for all other terminals (Boards A5, A3, A1, B1). Please refer to specific relay board user manuals.
- The tightening torques for the option board terminals (listed in **Table 4-1**) should be followed.

Table 4-1: Tightening Torques of Terminals

Terminal Screw	Tightening Torque	
	lb-in	**Nm**
Relay and thermistor terminals (M3 screw)	4.5	0.5
Other terminals (M2.6 screw)	2.2	0.25

Control Wiring Instructions

Table 4-2: Control Wiring Instructions

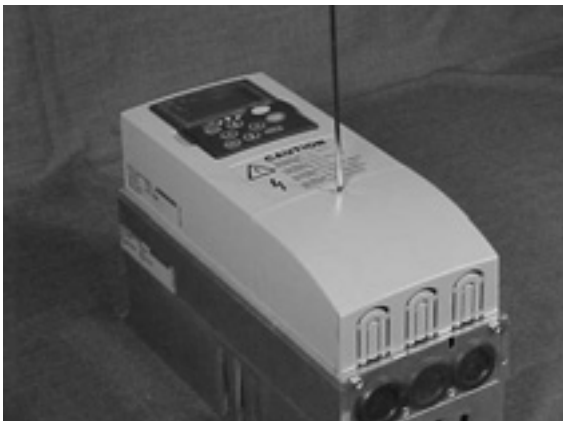
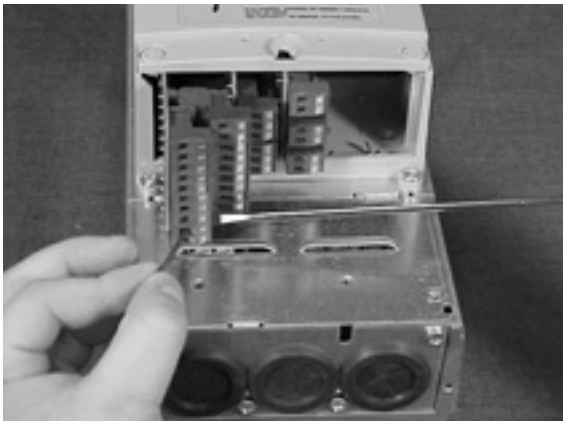
1. Unlock the bottom cover by turning the locking screw 90 degrees counterclockwise.	
2. Remove the bottom cover by rotating the cover toward you on the base hinges and lifting it away from the base.	

Table 4-2: Control Wiring Instructions (Continued)

3. Wire the control terminals following the details for the specific option boards shown on the following pages. **Note:** For ease of access, the option board terminal blocks can be unplugged for wiring.	

Control Wiring Details

Wiring Option Board A9

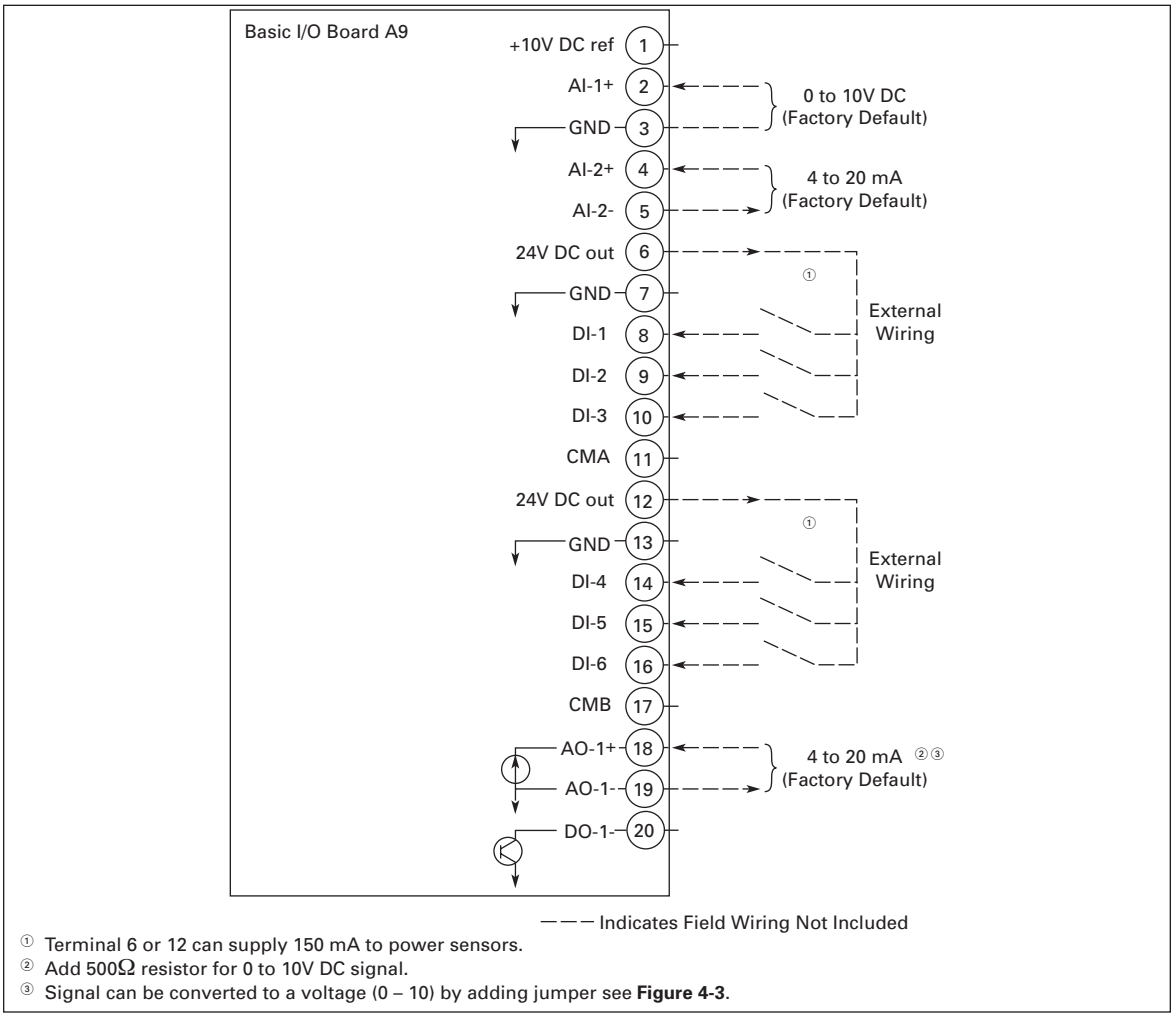


Figure 4-2: Option Board A9 Wiring Diagram

Table 4-3: Option Board A9 Terminal Descriptions

Terminal		Signal		Description and Parameter Reference
1	+10 V_{ref}	Reference voltage		Maximum current 10 mA
2	AI-1+	Analog input, voltage		Default: 0 to +10V (R_i = 200 kΩ; -10V to +10V joystick control) 0 to 20 mA (R_i = 250 Ω) Select V or mA with jumper block X1 (**Figure 4-3**). Differential input if not connected to ground; allows ±20V differential mode voltage to GND
3	GND	Analog input common		
4	AI-2+	Analog input		Default:4 to 20 mA (R_i = 250 Ω) 0 to +10V (R_i = 200 kΩ; -10V to +10V joystick control) Select V or mA with jumper block X2 (**Figure 4-3**). Differential input if not connected to ground; allows ±20V differential mode voltage to GND
5	GND/ AI-2-	Analog input common		
6	24 V_{out}	24V control voltage (bi-directional)		±15%, 250 mA (all boards total); 150 mA (max. current from single board). Can be used as external power backup for the control and fieldbus; galvanically connected to terminal 12.
7	GND	I/O ground		Ground for reference and controls; galvanically connected to terminals 13, 19
8	DIN1	Digital input 1	Start	R_i = min. 5 kΩ, Programmable
9	DIN2	Digital input 2	Ext. fault closed	R_i = min. 5 kΩ, Programmable
10	DIN3	Digital input 3	Fault reset	R_i = min. 5 kΩ, Programmable
11	CMA	Digital input common A for DIN1, DIN2 and DIN3		Must be connected to GND or 24V of I/O terminal or to external 24V or GND. Select with jumper block X3 (**Figure 4-3**).
12	24 V_{out}	24V control voltage (bi-directional)		Same as terminal 6; galvanically connected to terminal 6
13	GND	I/O ground		Same as terminal 7; galvanically connected to terminals 7 and 19
14	DIN4	Digital input 4	Vibration alarm	R_i = min. 5 kΩ, programmable
15	DIN5	Digital input 5	Vibration fault	R_i = min. 5 kΩ, programmable
16	DIN6	Digital input 6	Overload fault	R_i = min. 5 kΩ, programmable
17	CMB	Digital input common B for DIN4, DIN5 and DIN6		Must be connected to GND or 24V of I/O terminal or to external 24V or GND. Select with jumper block X3 (**Figure 4-3**).
18	AO-1+	Analog signal (+output)		Current: 4 to 20 mA Default, RL max. 500Ω or Voltage: 0 to 10V, RL >1 kΩ Select with jumper block X6 (**Figure 4-3**).
19	AO-1-	Analog output common		Maximum V_{in} = 48V DC; galvanically connected to terminals 7, 13
20	DO-1	Digital output1	Ready	Open collector; maximum current = 50 mA

Default Jumpers

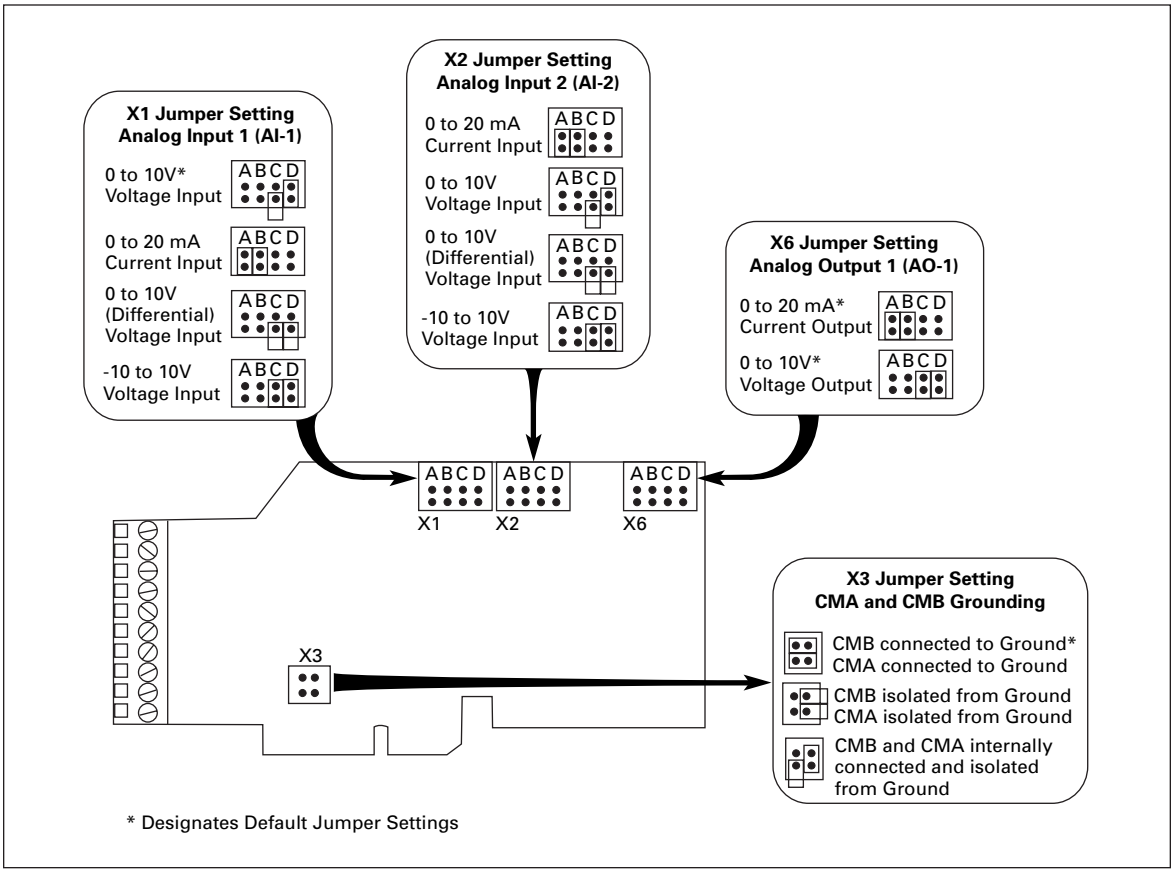

X1 Jumper Setting
Analog Input 1 (AI-1)
0 to 10V* Voltage Input
0 to 20 mA Current Input
0 to 10V (Differential) Voltage Input
-10 to 10V Voltage Input
X2 Jumper Setting
Analog Input 2 (AI-2)
0 to 20 mA Current Input
0 to 10V Voltage Input
0 to 10V (Differential) Voltage Input
-10 to 10V Voltage Input
X6 Jumper Setting
Analog Output 1 (AO-1)
0 to 20 mA* Current Output
0 to 10V* Voltage Output
A B C D
X1
X2
X6
X3
X3 Jumper Setting
CMA and CMB Grounding
CMB connected to Ground*
CMA connected to Ground
CMB isolated from Ground
CMA isolated from Ground
CMB and CMA internally connected and isolated from Ground
* Designates Default Jumper Settings

Figure 4-3: Option Board A9 Jumper Location and Settings

Wiring Option Board A2

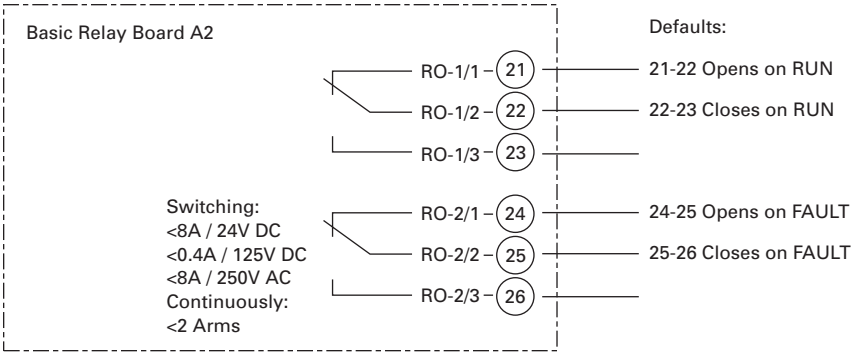


Figure 4-4: Option Board A2 Wiring Diagram

Table 4-4: Option Board A2 Terminal Descriptions

Terminal		Signal	Description and Parameter Reference	
21	RO-1/1	Normally Closed (NC)	Run	Switching capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4Az Min. switching load: 5V/10 mA Continuous capacity: <2 Arms
22	RO-1/2	Common		
23	RO-1/3	Normally Open (NO)		
24	RO-2/1	Normally Closed (NC)	Fault	Switching capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4A Min. switching load: 5V/10 mA Continuous capacity: <2 Arms
25	RO-2/2	Common		
26	RO-2/3	Normally Open (NO)		

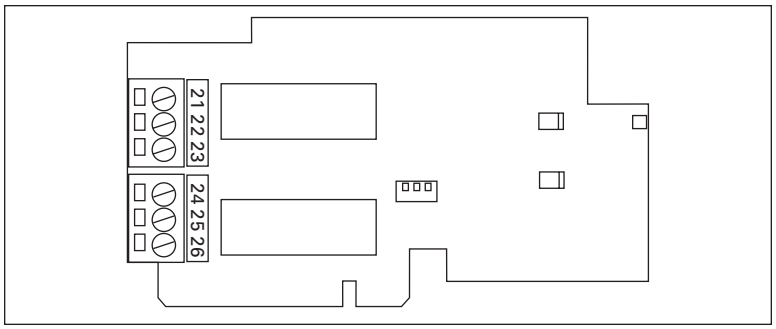


Figure 4-5: Option Board A2 Terminal Locations

Inverting the Digital Input Signal

The active signal level depends on which potential the common inputs CMA and CMB (terminals 11 and 17) are connected to. The alternatives are either +24V or ground (0V). See **Figure 4-6**.

The 24-volt control voltage and the ground for the digital inputs and common inputs (CMA, CMB) can be either the internal 24V supply or an external supply.

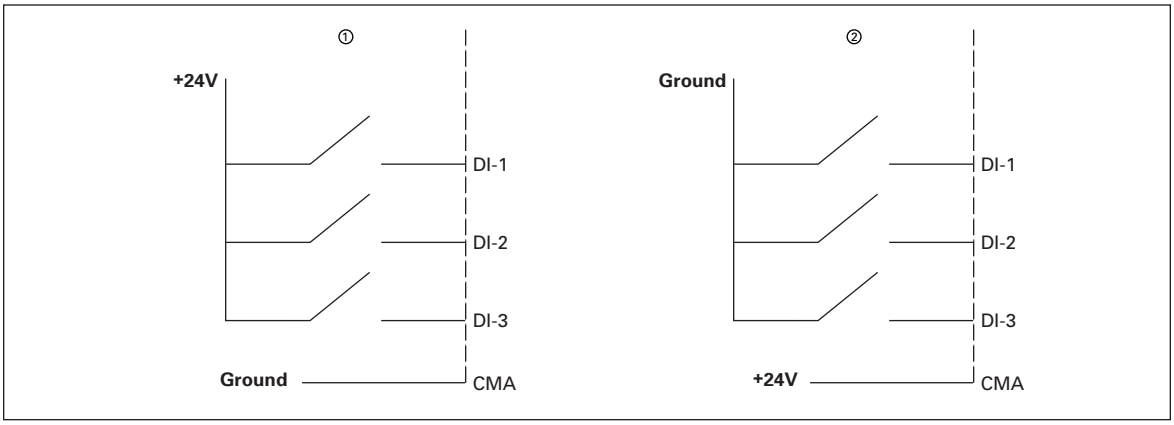


Figure 4-6: Positive/Negative Logic

① Positive logic (+24V is the active signal) = Input is active when the switch is closed.
② Negative logic (0V is the active signal) = Input is active when the switch is closed.

August 2006

Chapter 5 — Bypass Feature/Maintenance and Installation

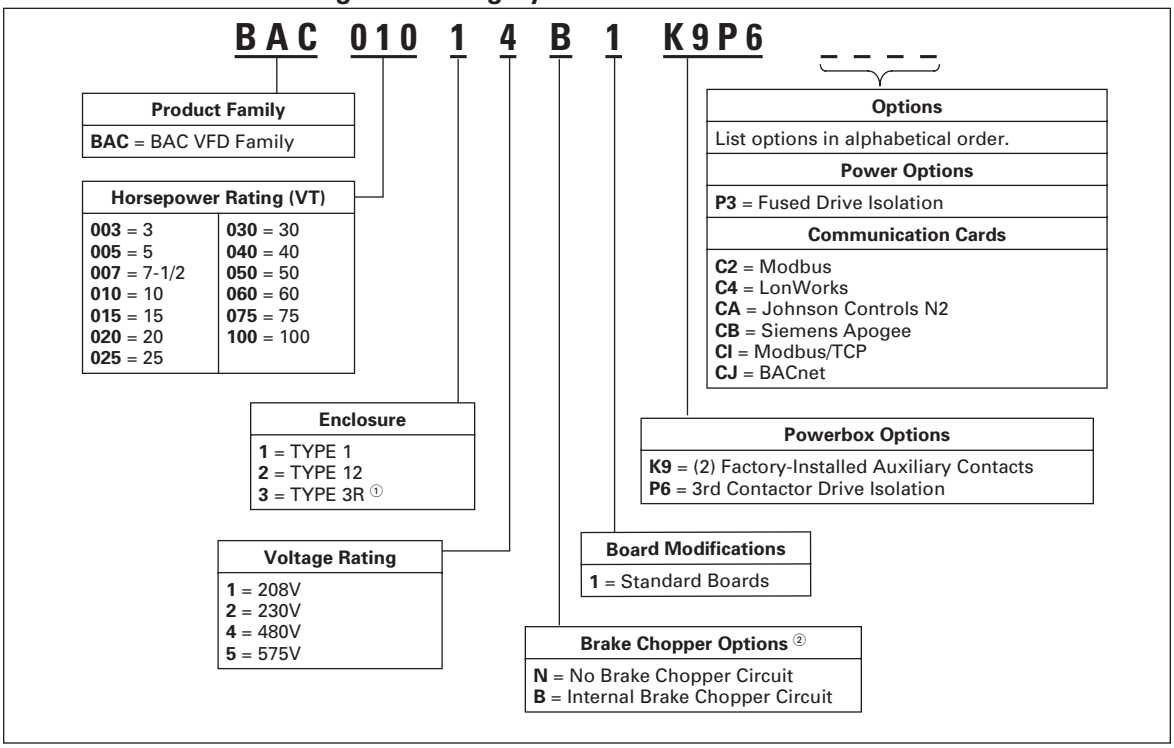
Product Description

The BAC VFD provides a premier intelligent drive integrated with a reliable bypass configuration.

The BAC bypass is a three-contactor design utilizing a 24V DC series of contactors and power supplies. The features, function and form allow the drive and bypass to become an integrated design, enabling BAC to introduce the world's smallest drive and bypass package. The BAC VFD comes standard with a protective disconnect integrated into the drive and bypass design.

Catalog Numbering System

Table 5-1: BAC VFD Catalog Numbering System



① Space heater is included in TYPE 3R enclosure.

② 480V Drives up to 40 hp (VT) are only available with Brake Chopper Option **B**.
480V Drives 50 hp (VT) or larger are only available with Brake Chopper Option **N**.
230V Drives up to 20 hp (VT) are only available with Brake Chopper Option **B**.
575V Drives are standard without Brake Chopper Option **N**.

Note: Availability
208V: 3 – 60 hp, 230V: 3 – 75 hp, 480V: 3 – 150 hp, 575V: 3 – 100 hp

Dimensions

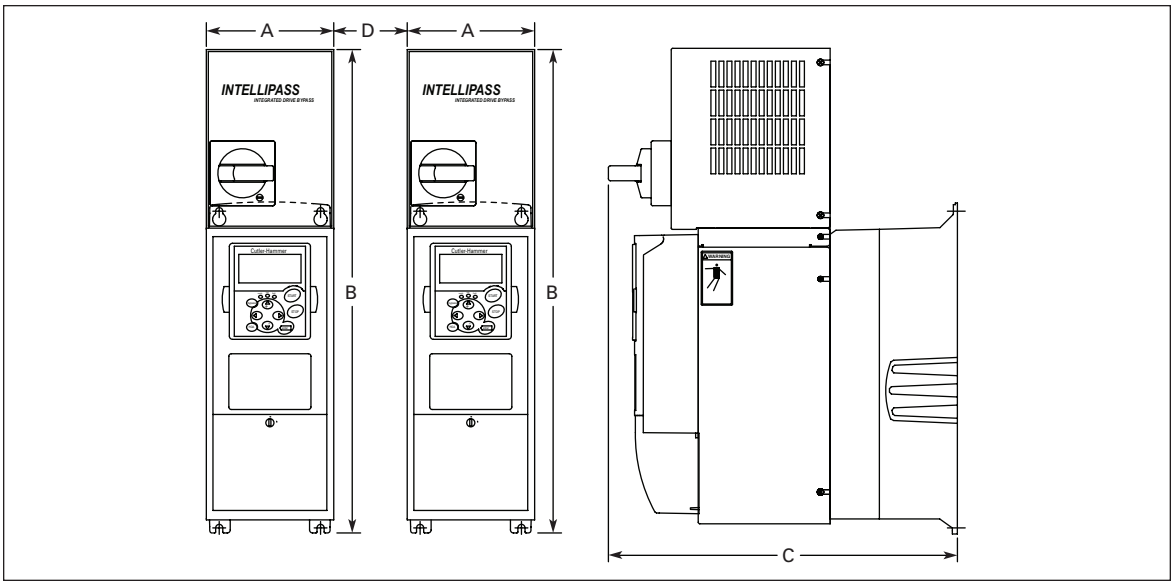


Figure 5-1: BAC TYPE 1 Bypass VFD Dimensions

Table 5-2: BAC TYPE 1 Bypass VFD Information

Drive Horsepower (VT)	Frame Size	Approximate Dimensions in Inches (mm)			Approx. Weight in lbs. (kg)	Distance Between Drives in Inches (mm) ①
		A	B	C		D
208V, 1 – 3 hp 230V, 1 – 3 hp 480V, 1 – 7-1/2 hp	FR4	5.04 (128)	18.25 (464)	13.24 (336)	21 (9.5)	5.3 (134.6)
208V, 5 – 7-1/2 hp 230V, 5 – 10 hp 480V, 10 – 20 hp	FR5	5.50 (140)	23.25 (591)	13.24 (336)	35 (15.9)	5.7 (144.8)
208V, 10 – 20 hp 230V, 15 and 20 hp 480V, 25 – 40 hp	FR6	7.50 (191)	29.38 (746)	15.25 (387)	67 (30.4)	7.5 (190.5)
208V, 25 and 30 hp 230V, 25 and 30 hp 480V, 50 – 75 hp	FR7	9.10 (231)	37.53 (953)	15.25 (387)	108 (49.0)	9.0 (228.6)

① If mounting two or more Intellipass Drives next to each other, make sure to use the proper spacing between the drives for hinged door operation.

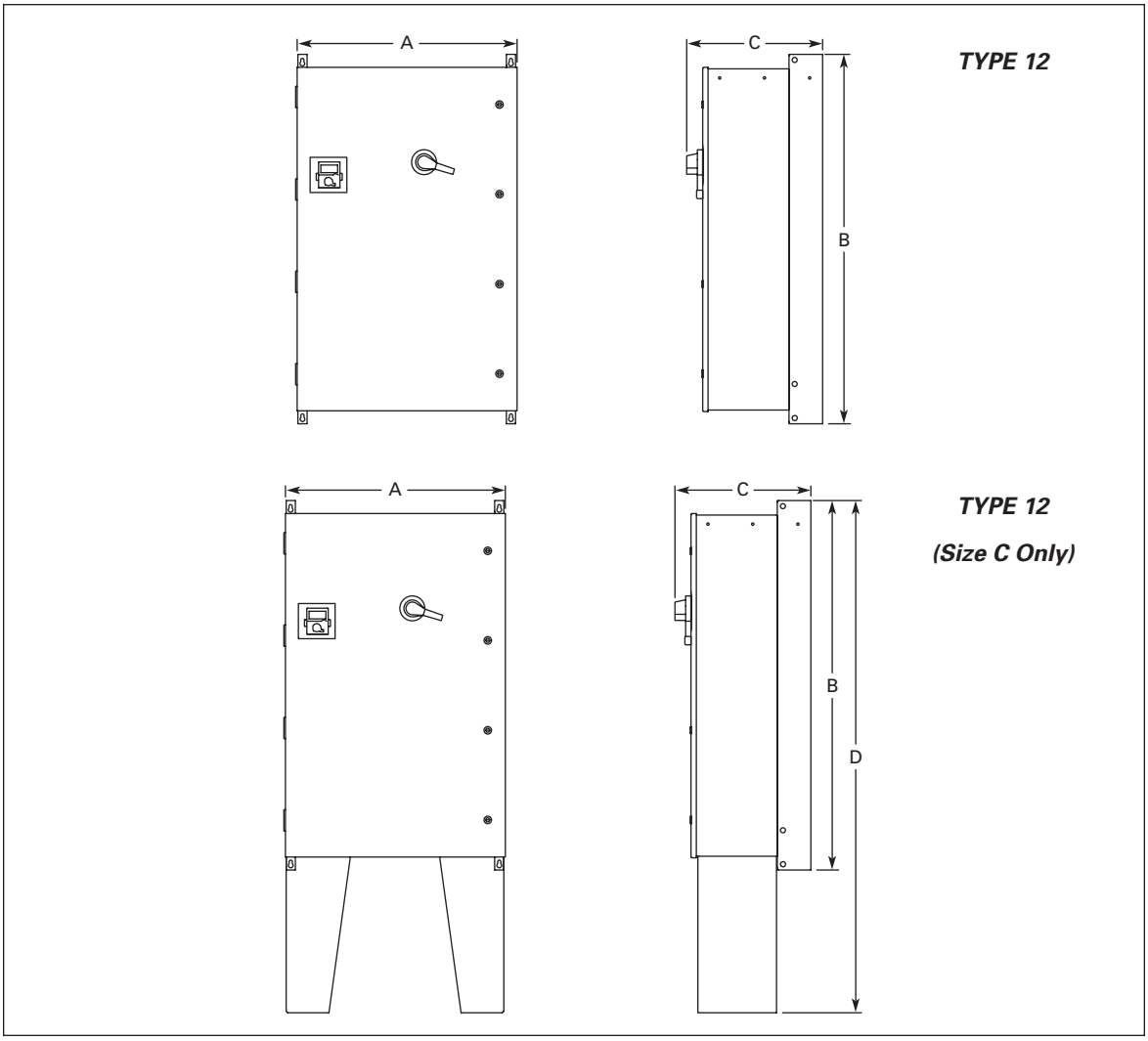


Figure 5-2: BAC TYPE 12 Enclosed VFD Dimensions

Table 5-3: BAC TYPE 12 Enclosed Bypass VFD Dimensions

Drive Horsepower (VT)	Frame Size	Enclosure Box	Approximate Dimensions in Inches (mm)				Approx. Wt. in lbs. (kg)	Approx. Ship. Wt. in lbs. (kg)
			A	B	C	D ①		
208V, 1-1/2 – 15 hp 230V, 1-1/2 – 15 hp 480V, 1-1/2 – 30 hp 575V, 3 – 30 hp	FR4 – FR6 FR4 – FR6 FR4 – FR6 FR6	A	16.92 (429.8)	29.00 (736.6)	18.60 (472.4)	—	120 (54)	160 (73)
208V, 20 – 30 hp 230V, 20 – 30 hp 480V, 40 – 75 hp 575V, 40 – 50 hp	FR6 – FR7 FR6 – FR7 FR7 FR7	B	20.92 (531.3)	40.00 (1016.0)	19.10 (485.1)	—	185 (84)	229 (104)
208V, 40 – 60 hp 230V, 40 – 75 hp 480V, 100 – 150 hp 575V, 60 – 100 hp	FR8 FR8 FR8 FR8	C	30.92 (785.3)	52.00 (1320.8)	19.10 (485.1)	72.00 (1828.8)	315 (143)	430 (195)

① Floor Stands available on Box C only and can be purchased and shipped separately as kit.

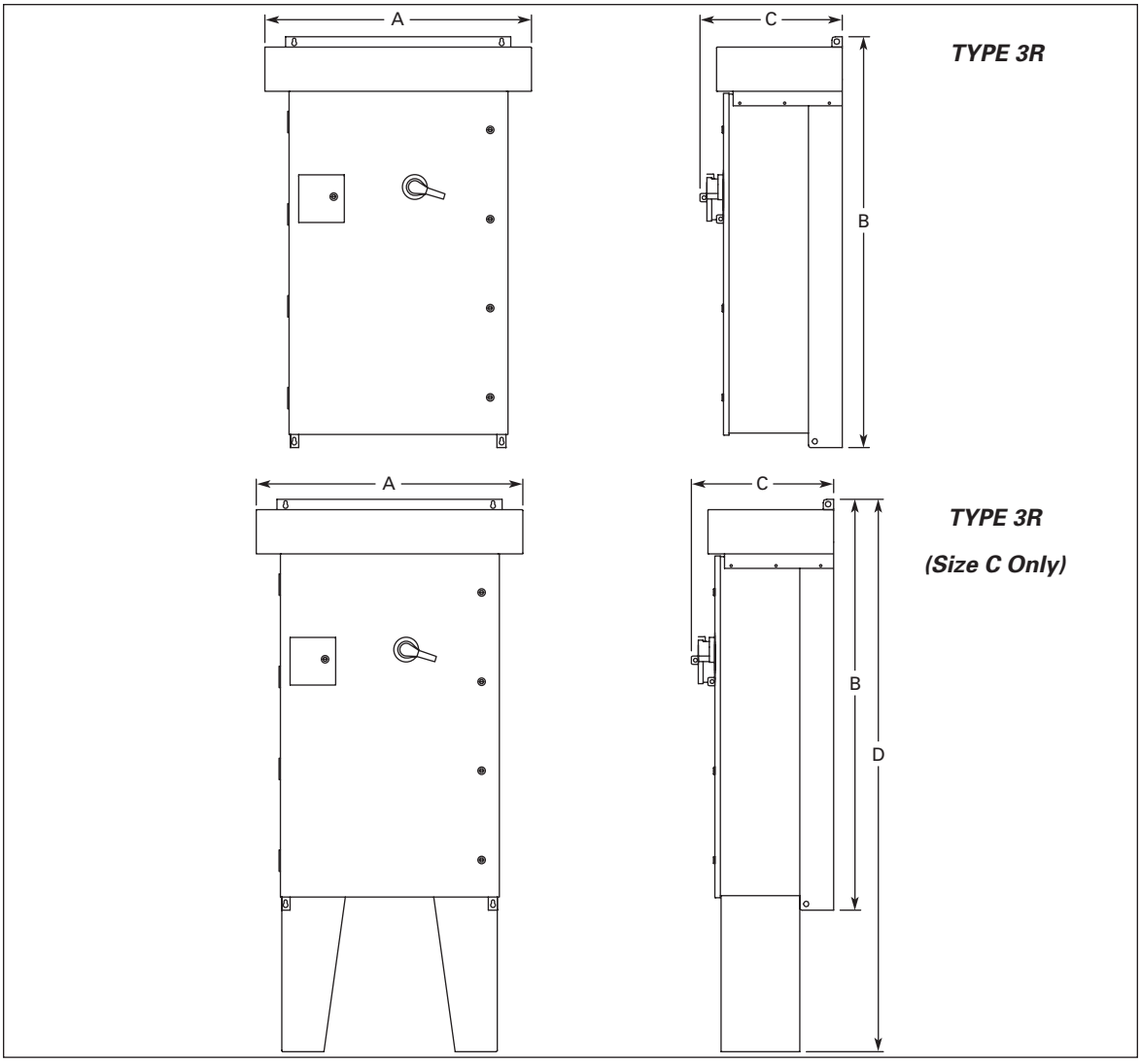


Figure 5-3: BAC TYPE 3R Enclosed VFD Dimensions

Table 5-4: BAC TYPE 3R Enclosed Bypass VFD Dimensions

Drive Horsepower (VT)	Frame Size	Enclosure Box	Approximate Dimensions in Inches (mm)				Approx. Wt. in lbs. (kg)	Approx. Ship. Wt. in lbs. (kg)
			A	B	C	D ①		
208V, 7-1/2 – 15 hp 230V, 7-1/2 – 15 hp 480V, 7-1/2 – 30 hp 575V, 3 – 30 hp	FR5 – FR6 FR5 – FR6 FR4 – FR6 FR6	A	21.05 (534.7)	33.00 (838.2)	19.57 (497.0)	—	170 (77)	215 (98)
208V, 20 – 30 hp 230V, 20 – 30 hp 480V, 40 – 75 hp 575V, 40 – 50 hp	FR6 – FR7 FR6 – FR7 FR7 FR7	B	26.31 (668.3)	46.09 (1170.7)	20.07 (509.9)	—	235 (107)	290 (132)
208V, 40 – 60 hp 230V, 40 – 75 hp 480V, 100 – 150 hp 575V, 60 – 100 hp	FR8 FR8 FR8 FR8	C	37.73 (958.3)	58.09 (1475.5)	20.08 (510.0)	78.09 (1983.5)	410 (186)	525 (238)

① Floor Stands available on Box C only and can be purchased and shipped separately as kit.

Power Wiring

Bypass Power Wiring for TYPE 3R and 12

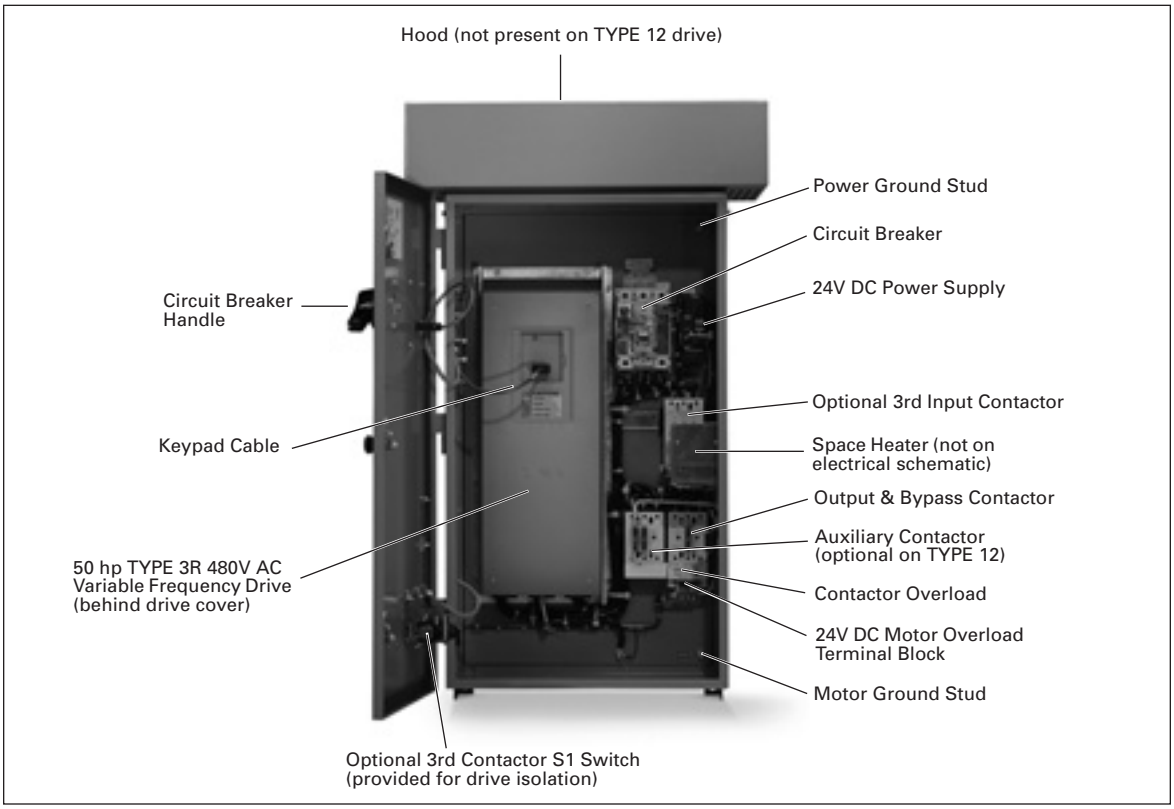

Hood (not present on TYPE 12 drive)
Power Ground Stud
Circuit Breaker
24V DC Power Supply
Circuit Breaker Handle
Optional 3rd Input Contactor
Keypad Cable
Space Heater (not on electrical schematic)
Output & Bypass Contactor
Auxiliary Contactor (optional on TYPE 12)
50 hp TYPE 3R 480V AC Variable Frequency Drive (behind drive cover)
Contactor Overload
24V DC Motor Overload Terminal Block
Motor Ground Stud
Optional 3rd Contactor S1 Switch (provided for drive isolation)

Figure 5-4: Identification of TYPE 3R Components

Note: You will need to consult the electrical schematic supplied with the drive and the appropriate wiring diagram in Appendix D.

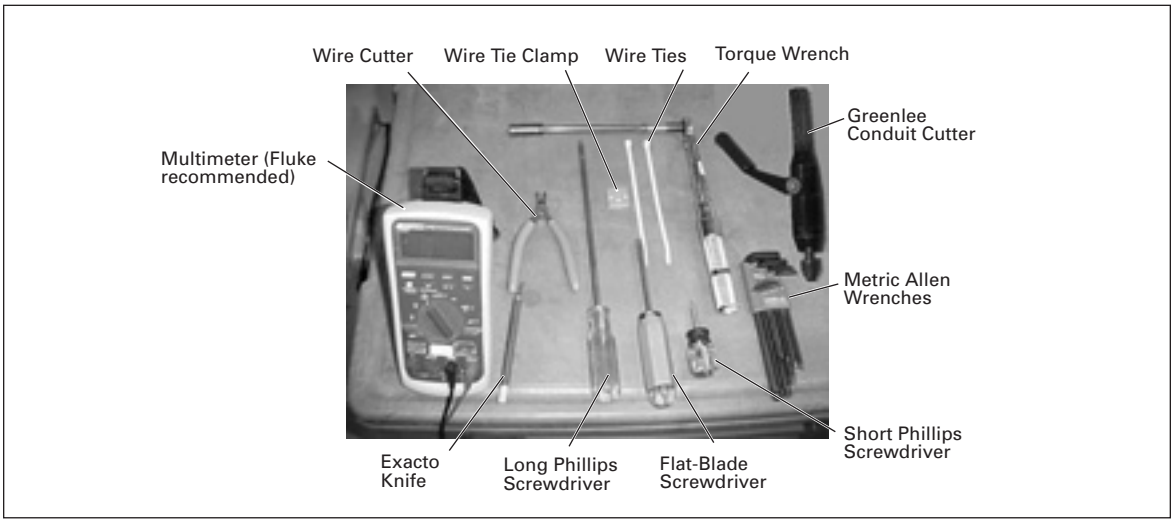


Figure 5-5: Tools Required

Table 5-5: Bypass Power Wiring Instructions — TYPE 3R and 12

<table>
<tr>
<td>

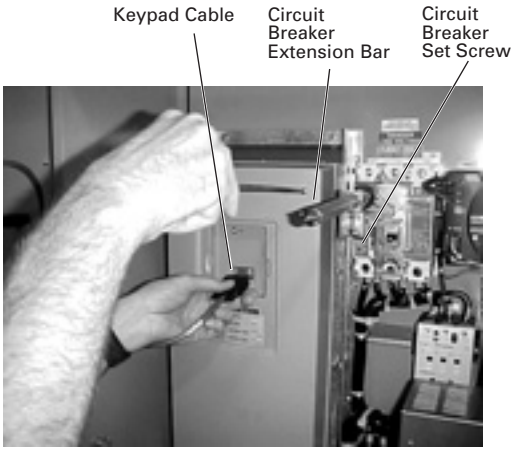
1. Verify that the main power source is removed upstream.
2. Remove the keypad cable from the drive.
3. Remove the screws from the drive cover, and remove the cover.

⚠ CAUTION

The circuit breaker extension bar is sharp and can cause injury.

4. Calibrate the circuit breaker amperage, so it is 1.25 times the value on the motor nameplate, by turning the red set screw located below the circuit breaker extension bar. See the circuit breaker user's manual supplied with the drive.

</td>
<td>



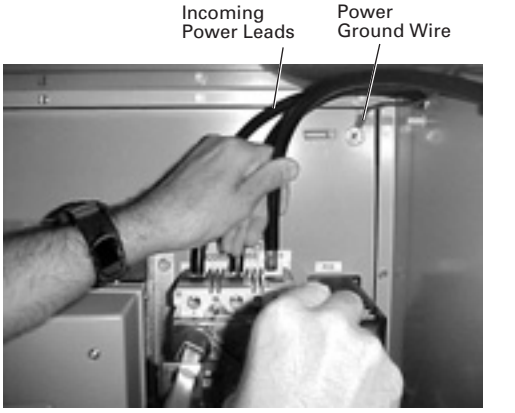
</td>
</tr>
<tr>
<td>

5. Using a Greenlee conduit cutter (recommended), cut three holes in the drive's enclosure for the incoming power, motor and low-voltage control leads.

Note: Power, motor and control leads must each be located in separate conduit.

6. Connect the incoming power leads to circuit breaker terminals labeled L1, L2 and L3.
7. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
8. Connect the power ground wire to the ground stud.

</td>
<td>



</td>
</tr>
</table>

Table 5-5: Bypass Power Wiring Instructions — TYPE 3R and 12, continued

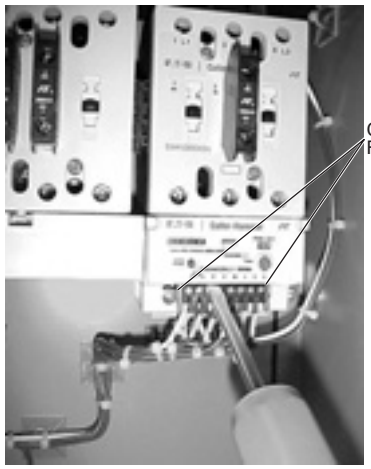
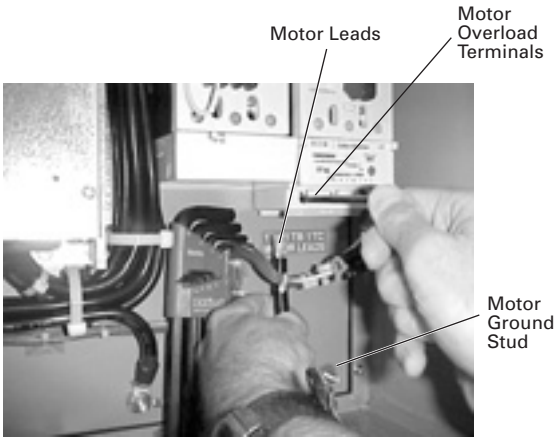
9. If applicable, set the space heater. See the space heater user's manual supplied with the drive. **Note:** The space heater is used to prevent condensation from damaging the equipment when the drive is not operating (OFF).	
10. Use your first and second fingers and simultaneously push down to release the two orange retaining clips (one on each side of the 24V DC motor overload terminal block). 11. If necessary, use a flat-blade screwdriver to carefully remove the terminal block in a straight plane to avoid damaging it.	
12. Lift to open the cover on the motor overload, and use a flat-blade screwdriver to set the overload amperage to match the value on the motor nameplate. 13. Turn the auto/manual reset (factory default is manual) on the motor overload 90° to the auto position.	

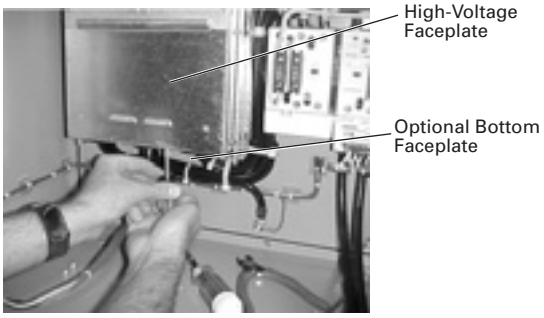
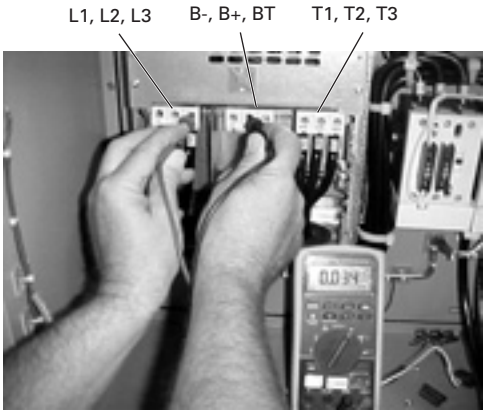
Table 5-5: Bypass Power Wiring Instructions — TYPE 3R and 12, continued

<table>
<tr>
<td>
14. Connect the motor leads to the motor overload terminals labeled 1TA, 1TB and 1TC.
15. Using the appropriate metric Allen wrench (2.5 mm, 3 mm or 4 mm), tighten each overload terminal per the specifications in the contactor user's manual.
⚠ CAUTION
An English Allen wrench will damage the terminals, and the motor overload will need to be replaced (not covered by warranty).
16. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
17. Reinsert the motor overload terminal block.
18. Connect the motor ground wire to the ground stud.
</td>
<td>


</td>
</tr>
<tr>
<td>
19. Use a flat-blade screwdriver to carefully remove the low-voltage I/O terminal block.
20. Insert the incoming control leads into the terminal block. Refer to the electrical schematic supplied with the drive.
21. Reinsert the I/O terminal block into the control board.
</td>
<td>

</td>
</tr>
</table>

Table 5-5: Bypass Power Wiring Instructions — TYPE 3R and 12, continued

22. Use a Phillips screwdriver to remove all the faceplate screws on the high-voltage faceplate, and remove the faceplate. **Note:** Location of the screws may vary from the drive illustrated. There may be screws securing a bottom faceplate, which also need to be removed.	
23. Make sure power is off, and perform static checks as described in **Table 5-6** (for the converter), **Table 5-7** (for the inverter) and **Table 5-8** (for the DC bus). **Note:** Static check shown is for L3 and B+ terminals. 24. Once the pre-power static checks are completed, reinstall the faceplate and drive cover, tightening all the screws. 25. Reinsert the keypad cable.	
26. Make sure that the drive's 3rd contactor S1 switch, if present, is in the ON position (shown in OFF position). **Note:** The bypass mode operates with the switch in the OFF position, however the drive will not run. Yet the keypad will operate.	
27. Close the drive door, and turn the circuit breaker handle in a clockwise direction. **Note:** If the circuit breaker latch is locked, use a flat-blade screwdriver to turn the screw to release the handle. **⚠ WARNING** High Voltage • Always work with another person • Be sure equipment is properly grounded • Wear safety glasses	

Static Checking

Static checking tests the integrity of the power-carrying components (diodes, capacitors and IGBTs) within the drive assembly. Performing these static checks ensures that no damage occurred during shipping or installation that could cause a failure when the drive is powered.

⚠ IMPORTANT

Make sure there is no power to the drive before proceeding with any of the static checks.

After checking each set of terminals, zero out the multimeter by touching the metal tips of the red (positive) and black (negative) leads to each other.

Note: Set the multimeter to the diode function, and check each power terminal consecutively with each DC bus terminal as indicated in **Table 5-6**.

Table 5-6: Static Checks of Converter

DC Bus Terminal	Power Terminal			Multimeter Reading
	L1	L2	L3	
B+ (1st Overload Check) Insert red (+) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	.OL
B- (2nd Overload Check) Insert black (-) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	.OL
B- (1st Voltage Check) Insert red (+) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	.25 – .55V DC (±10%)
B+ (2nd Voltage Check) Insert black (-) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	.25 – .55V DC (±10%)

Note: Set the multimeter to the diode function, and check each motor terminal consecutively with each DC bus terminal as indicated in **Table 5-7**.

Table 5-7: Static Checks of Inverter

DC Bus Terminal	Motor Terminal on Contactor if Bypass			Multimeter Reading
	T1	T2	T3	
B+ (1st Overload Check) Insert red (+) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	.OL
B- (2nd Overload Check) Insert black (-) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	.OL
B- (1st Voltage Check) Insert red (+) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	Insert black (-) multimeter lead.	.25 – .40V DC (±10%)
B+ (2nd Voltage Check) Insert black (-) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	Insert red (+) multimeter lead.	.25 – .40V DC (±10%)

Note: Set the multimeter to the ohm function, and check the power ground terminal and DC bus terminals as indicated in **Table 5-8**.

Table 5-8: Static Checks of DC Bus

DC Bus Terminal	DC Bus Terminal (B-)	Ground Terminal (Power)	Multimeter Reading
B+ (Overload Check) Insert red (+) multimeter lead.	Insert black (-) multimeter lead.	Not used.	.OL
B+ (1st Ohm Check) Insert black (-) multimeter lead.	Not used.	Insert red (+) multimeter lead.	O.L
B- (2nd Ohm Check) Insert black (-) multimeter lead.	Not used.	Insert red (+) multimeter lead.	O.L

Figure 5-6 is a detailed schematic to aid in performing the static checks.

Continuity Test to Ground

Test L1, L2, L3 to ground.
T1, T2, T3 to ground.

This should read .OL ohms.

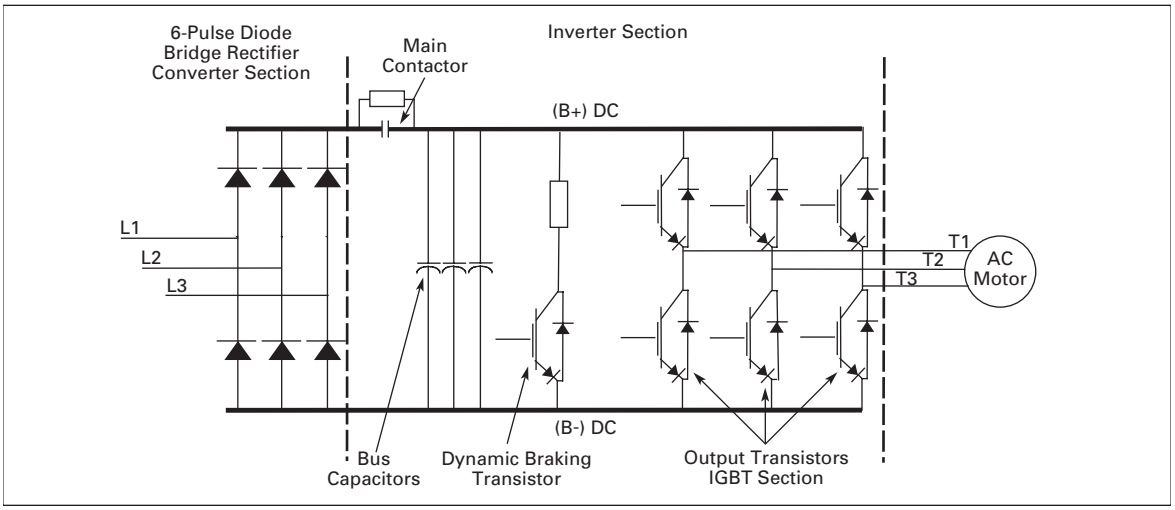


Figure 5-6: Schematic for Static Checks

Bypass Power Wiring for TYPE 1

Use the same tools shown in **Figure 5-5** to install a TYPE 1 Drive.

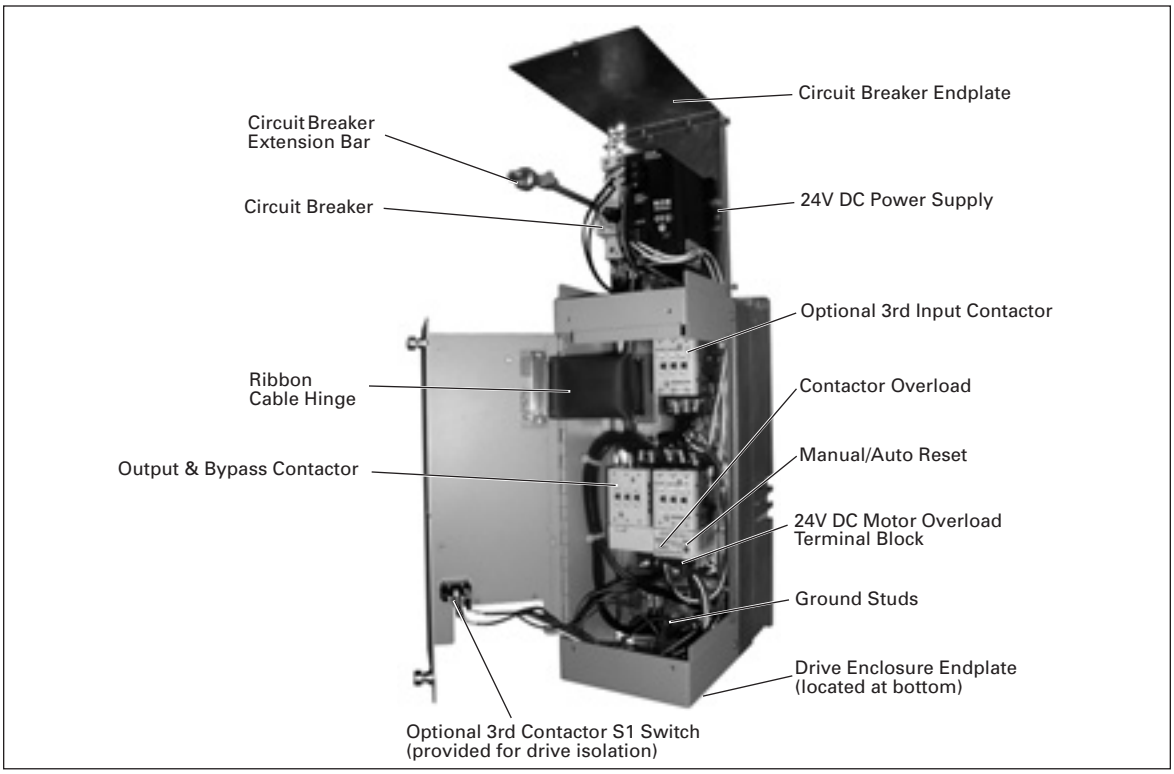


Figure 5-7: Identification of TYPE 1 Components

Note: You will need to consult the electrical schematic supplied with the drive and the appropriate wiring diagram in Appendix D. The Auxiliary Contactor is optional on TYPE 1 Drives.

Table 5-9: Bypass Power Wiring Instructions — TYPE 1

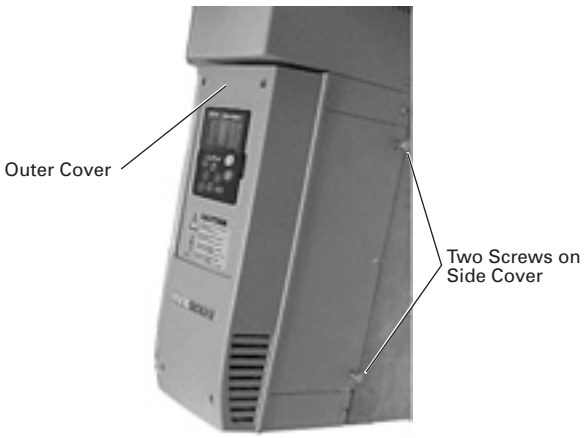
1. Verify that the main power source is removed upstream. 2. Using a flat-blade screwdriver, remove the four screws securing the outer cover of the drive and remove the cover. 3. Using the same screwdriver, remove the two center screws securing the side cover. 4. Make sure there is adequate room, and open the hinged side cover.	

Table 5-9: Bypass Power Wiring Instructions — TYPE 1, continued

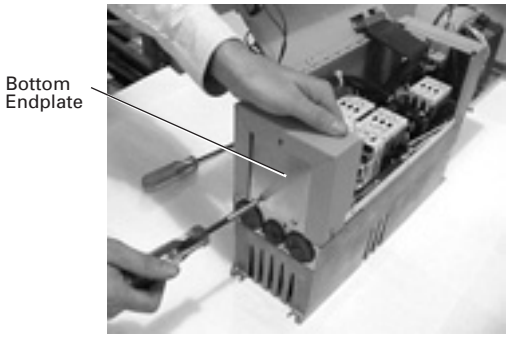
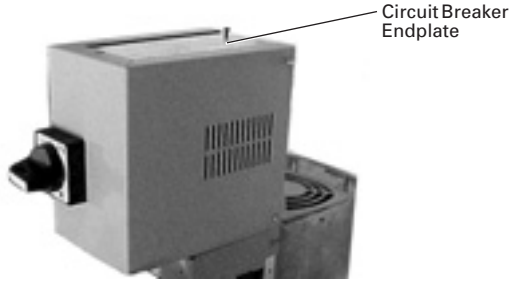
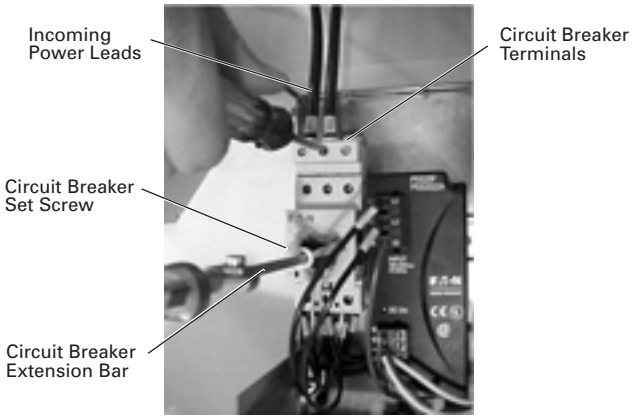
5. Using a flat-blade screwdriver, remove the screws securing the endplate at the bottom of the drive enclosure, and remove the endplate. 6. Using a Greenlee conduit cutter (recommended), cut one or more holes in the endplate, located at the bottom of the drive's enclosure, for the motor and power leads. **Note:** If bringing the power leads in through the top of the drive's enclosure, go to step 7. If not, proceed to step 9.	
7. Using a flat-blade screwdriver, remove the screws securing the endplate for the circuit breaker enclosure, and remove the endplate. 8. Using a Greenlee conduit cutter (recommended), cut one hole in the circuit breaker endplate for the power leads.	
9. Calibrate the circuit breaker amperage, so it is 1.25 times the value on the motor nameplate, by turning the yellow set screw located next to the circuit breaker extension bar. See the circuit breaker user's manual supplied with the drive. 10. Connect the incoming power leads to the circuit breaker terminals (L1, L2 and L3). 11. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.	

Table 5-9: Bypass Power Wiring Instructions — TYPE 1, continued

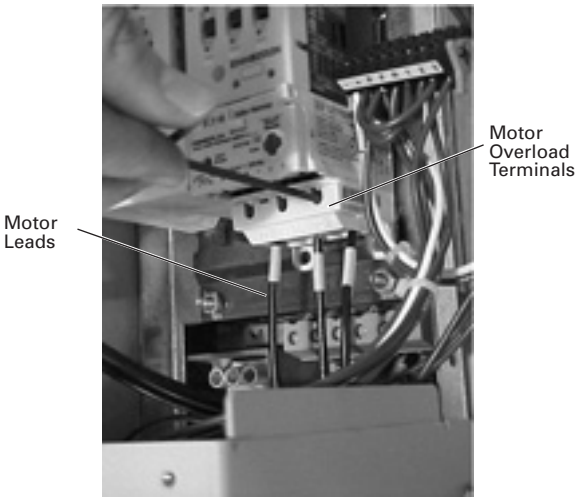
<table>
<tr>
<td>12. Use your first and second fingers and simultaneously push down to release the two orange retaining clips (one on each side of the 24V DC motor overload terminal block).
13. If necessary, use a flat-blade screwdriver to carefully remove the terminal block in a straight plane to avoid damaging it.</td>
<td> </td>
</tr>
<tr>
<td>14. Connect the motor leads to the motor overload terminals labeled 1TA, 1TB and 1TC.
15. Using the appropriate metric Allen wrench (2.5 mm, 3 mm or 4 mm), tighten each overload terminal per the specifications in the contactor user's manual.
⚠ CAUTION
An English Allen wrench will damage the terminals, and the motor overload will need to be replaced (not covered by warranty).
16. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
17. Reinsert the motor overload terminal block.</td>
<td> 
</td>
</tr>
</table>

Table 5-9: Bypass Power Wiring Instructions — TYPE 1, continued

18. Use a flat-blade screwdriver to connect the motor ground wire to the ground stud (located at either the top or bottom of the drive's enclosure).	
19. Lift to open the cover on the motor overload, and use a flat-blade screwdriver to set the overload amperage to match the value on the motor nameplate. 20. Turn the auto/manual reset (factory default is manual) on the motor overload 90° to the auto position.	
21. Use a flat-blade screwdriver to carefully remove the low-voltage I/O terminal block. 22. Insert the incoming control leads into the terminal block. Refer to the electrical schematic supplied with the drive. 23. Reinsert the I/O terminal block into the control board. 24. Verify that all other wires to the terminal block are connected.	

Table 5-9: Bypass Power Wiring Instructions — TYPE 1, continued

25. Make sure power is off, and perform static checks as described in "Static Checking" on **Page 5-10**. **Note:** Static check shown is for L3 and B+ terminals. See **Figure 5-6** for a detailed schematic to aid in performing the static checks. 26. Once the pre-power static checks are completed, reinstall the drive's outer and side covers, tightening all the screws.	
27. Make sure that the drive's 3rd contactor S1 switch, if present, is in the ON position (shown in OFF position). **Note:** The bypass mode operates with the switch in the OFF position, however the drive will not run. Yet the keypad will operate.	
28. Turn the circuit breaker handle in a clockwise direction. **⚠ WARNING** High Voltage • Always work with another person • Be sure equipment is properly grounded • Wear safety glasses	

Power and Motor Wiring Schematic

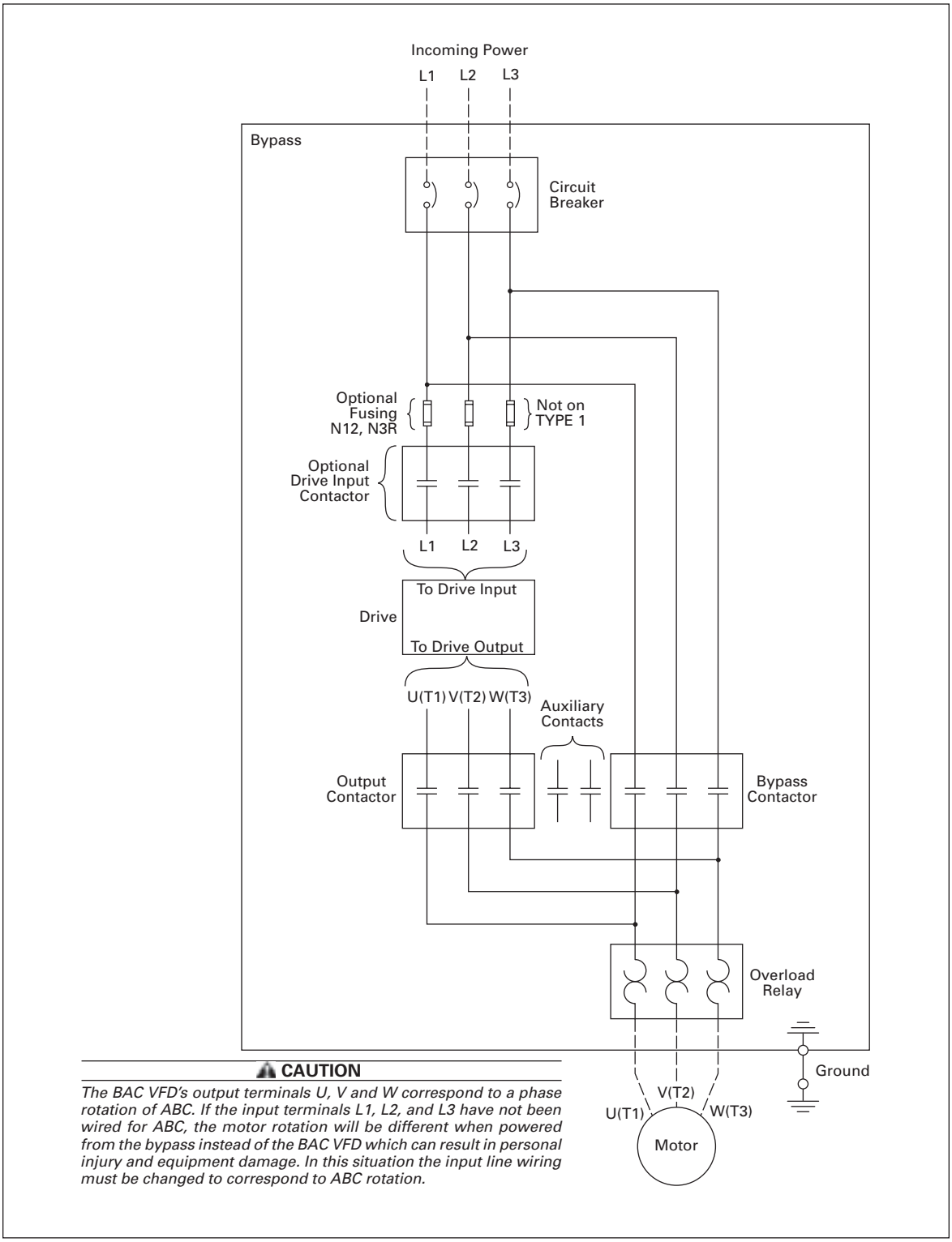

Incoming Power
L1
L2
L3
Bypass
Circuit Breaker
Optional Fusing N12, N3R
Not on TYPE 1
Optional Drive Input Contactor
L1
L2
L3
To Drive Input
Drive
To Drive Output
U(T1) V(T2) W(T3)
Auxiliary Contacts
Output Contactor
Bypass Contactor
Overload Relay
Ground
V(T2)
U(T1)
W(T3)
Motor
CAUTION
The BAC VFD's output terminals U, V and W correspond to a phase rotation of ABC. If the input terminals L1, L2, and L3 have not been wired for ABC, the motor rotation will be different when powered from the bypass instead of the BAC VFD which can result in personal injury and equipment damage. In this situation the input line wiring must be changed to correspond to ABC rotation.

Figure 5-8: Bypass Power and Motor Terminal Wiring Example

Bypass Control Wiring Instructions

Use the instructions and diagrams in Chapter 4 “Control Wiring” for wiring standard Option Boards A9 and A2.

In addition to these two boards, the bypass includes Option Board B5, which is described in the following section.

Wiring Option Board B5

This board should be mounted in slot C.

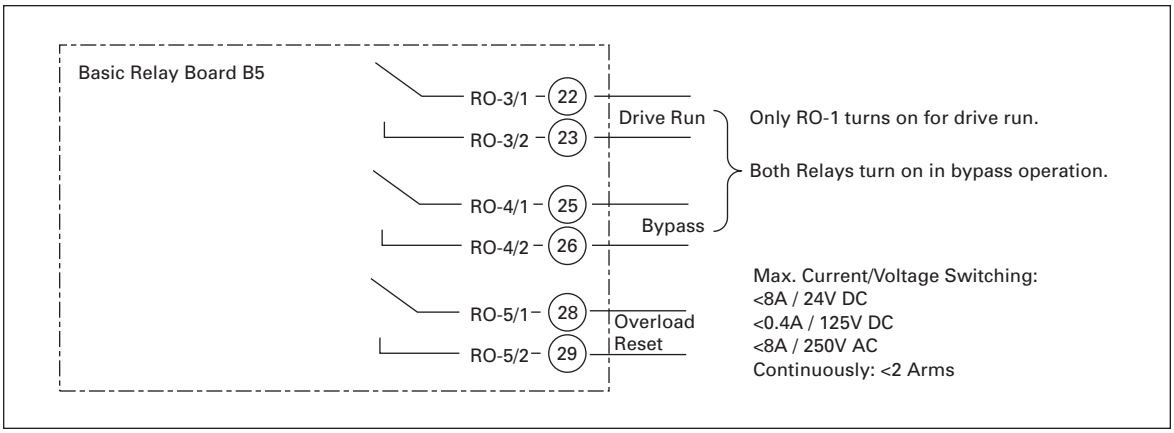


Figure 5-9: Option Board B5 Wiring Diagram

Table 5-10: Option Board B5 Terminal Descriptions

Terminal		Signal	Description and Parameter Reference	
22	RO-3/1	Common	Drive Run and Bypass Run	Switching capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4A Min. switching load: 5V/10 mA Continuously: <2 Arms
23	RO-3/2	Normally Open		
25	RO-4/1	Common	Bypass together with RO1 (Both are required for Bypass Operation.)	Switching capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4A
26	RO-4/2	Normally Open		
28	RO-5/1	Common	Overload Reset	Switching capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4A
29	RO-5/2	Normally Open		

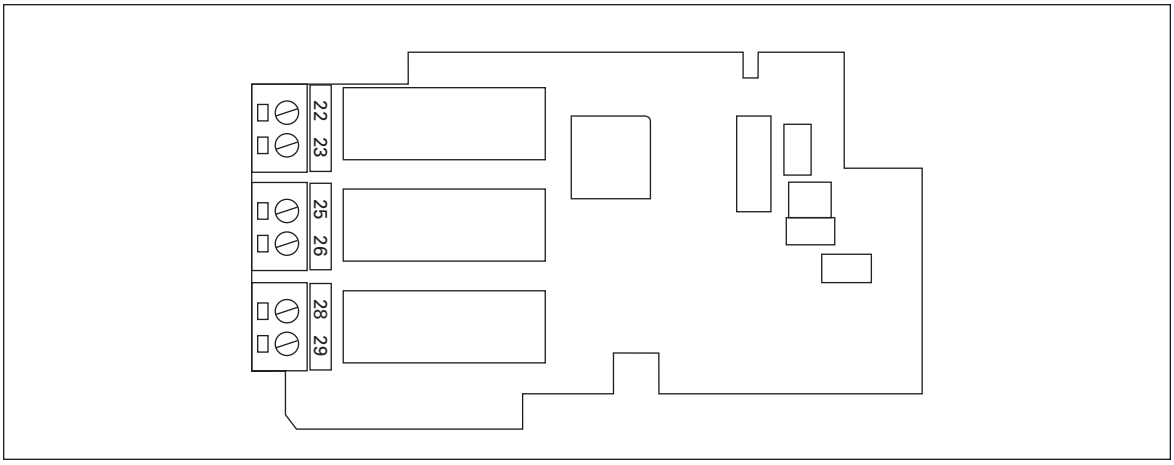


Figure 5-10: Option Board B5 Terminal Location

Note: Once enabled, bypass operation (across the input line) will be controlled through whichever control source is selected. Follow "Additional Instructions for Keypad Operation" on page 20 for keypad bypass operation.

Enabling Bypass

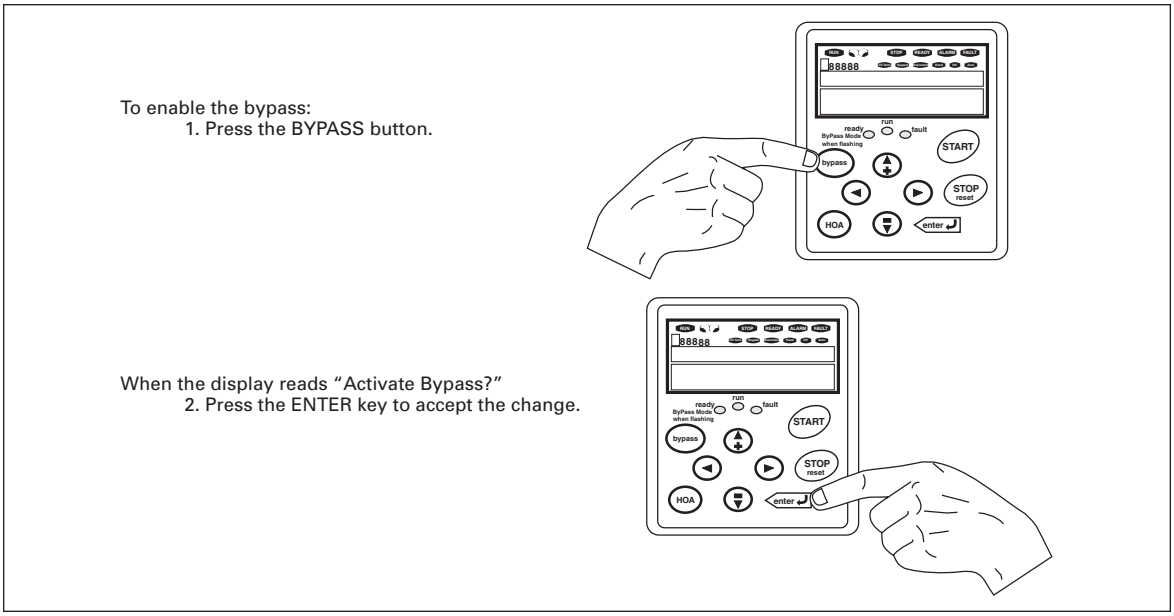


Figure 5-11: Enable Bypass

Additional Instructions for Keypad Operation

Procedure to run in bypass operation from keypad.

1. Press the BYPASS button: “Activate Bypass? Press ENTER” will appear on the keypad display. Press ENTER.
2. Press the HOA button to select desired control location, e.g., HAND. Bypass mode LED will start flashing.
3. Press the START button: “Motor Running in BYPASS!” will appear on the keypad display.
   - Motor is running in bypass.
   - Run LED is steady and Bypass LED is flashing.

Procedure to return to drive operation from keypad.

1. Press the STOP button.
2. Press the BYPASS button: “Return to Drive? Press Enter!” will appear on keypad display.
3. Press the ENTER button to return to drive operation.
   - Bypass is disabled.
   - Ready LED is steady.

BYPASS will be disabled in all control sources when B5 option board is removed from Slot C.

August 2006

Chapter 6 — Menu Information

Keypad Operation

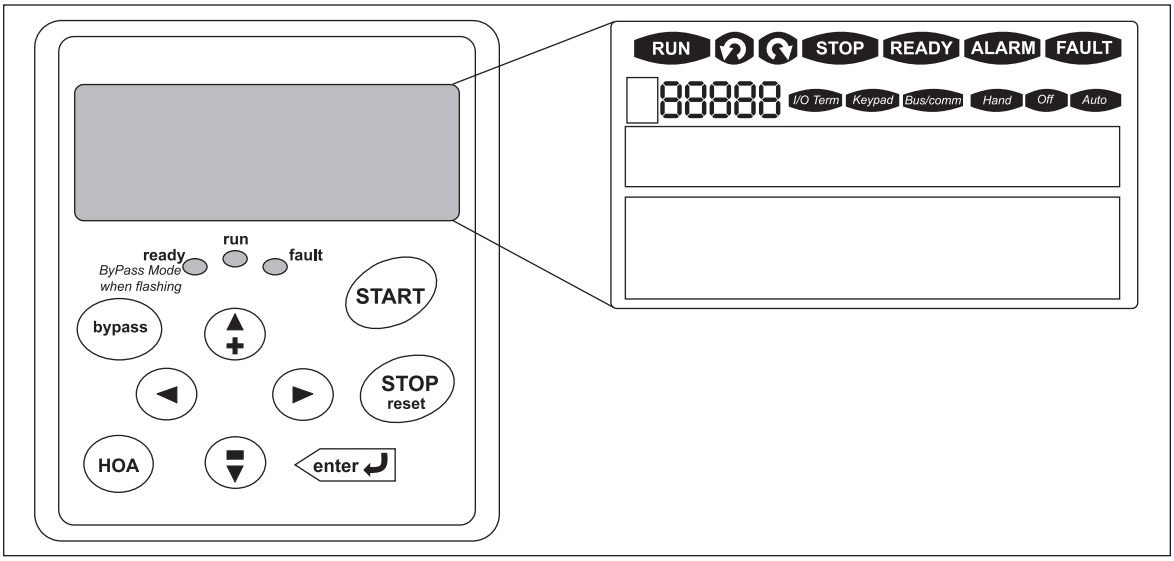


Figure 6-1: Keypad and Display

Table 6-1: LCD Status Indicators

Indicator	Description
RUN	**Run** Indicates that the BAC VFD is running and controlling the load in Drive or Bypass.
	Counterclockwise Operation The output phase rotation is **BAC**, corresponding to counterclockwise rotation of most motors.
	Clockwise Operation The output phase rotation is **ABC**, corresponding to clockwise rotation of most motors.
STOP	**Stop** Indicates that the BAC VFD is stopped and not controlling the load.
READY	**Ready** Indicates that the BAC VFD is ready to be started. Run Enable/INTLK DIN selection will disable "Ready."
ALARM	**Alarm** Indicates that there is one or more active drive alarm(s).
FAULT	**Fault** Indicates that there is one or more active drive fault(s).
I/O Term	**I/O Terminal** Indicates that the I/O terminal have been chosen for control.
Keypad	**Keypad** Indicates that the keypad has been chosen for control.
Bus/comm	**Bus/Communications** Indicates that the communications bus has been chosen for control.
Hand	**Hand** Indicates that HAND has been chosen in the HOA control mode.
Off	**Off** Indicates that the BAC VFD is stopped while in the HOA control mode.
Auto	**Auto** Indicates that AUTO has been chosen in the HOA control mode.

Table 6-2: LED Status Indicators

Indicator	Description
Ready	Steady Illumination — Indicates that the BAC VFD is ready to be started. Flashing — Indicates that the BAC VFD is in Bypass Mode.
Run	Indicates that the BAC VFD or Bypass is operating and controlling the load.
Fault	Indicates that there is one or more active drive fault(s).

Table 6-3: Navigation Buttons

Button	Description
START	**Start** This button operates as the start button for normal operation when the "Keypad" is selected as the active control.
enter	**Enter** This button in the parameter edit mode is used to: • Leave the programming mode • Leave the parameter group • Save the parameter setting and move to the next parameter This button is also used to reset Fault History by pressing ENTER when: • On the "Fault History" menu group in the "Monitoring Menu" or • In the "Fault History" menu.
STOP reset	**Stop/Reset** This button has three integrated functions. The button operates as the STOP button during normal operation. In the fault mode, it is used as the fault RESET button. It is also used to enter programming mode when pressed for two seconds from the "Operate Menu". This button is used to: • Stop the motor from the keypad • Reset the active fault • Reactivate Wizard Select (wait 5 seconds to activate)
bypass	**Bypass** Switches between the drive and bypass modes.
HOA	**HOA** Steps through Hand, Off and Auto control modes. Press "Enter" to select mode. If "Enter" is not pressed, control mode will remain in previous control mode.
◄	**Left Arrow** This button is used: • As a navigation button (movement to left) • In the display mode to enter the parameter group mode • To exit when in the parameter edit mode (backs up one step) • To cancel edited parameter (exit from a parameter edit mode) • In the "Operate Menu" to navigate through the monitoring values
►	**Right Arrow** This button is used: • As a navigation button (movement to right) • To enter the parameter group mode • To enter the parameter mode from a group mode • In the "Operate Menu" to navigate through the monitoring values
▲ + = ▼	**Up and Down Arrows** This button is used: • To move either up or down the parameter group list to select the desired group • To move either up or down the parameter list to select the desired parameter in the group • To increase/decrease the reference value of the selected parameter • In "Operate Menu" with the Keypad Reference or Keypad PID Setpoint active, pressing the up or down arrow changes the corresponding "Keypad Source" value

Main Menu Navigation

The data on the control keypad are arranged in menus and submenus. The first menu level consists of menus M1 to M8 and is called the Main menu. These menus and their submenus are illustrated in **Figure 6-2**.

Navigation Tips

- To navigate within one level of menu, use the up and down arrows.
- To move deeper into the menu structure and back out, use the right and left arrows.
- To edit a parameter, navigate to show that parameter's value and press the right arrow button to enter the edit mode. (In edit mode, the parameter value will flash.)
  - The parameter value can be changed by pressing the up or down arrow keys.
  - Pressing the right arrow a second time will allow you to edit the parameter value digit by digit.
  - To confirm the parameter change, press the ENTER key. (The value will not change unless the ENTER button is pressed.)

Note: For special navigation tips for M8, see "Operate Menu (M8)" on **Page 6-21**.

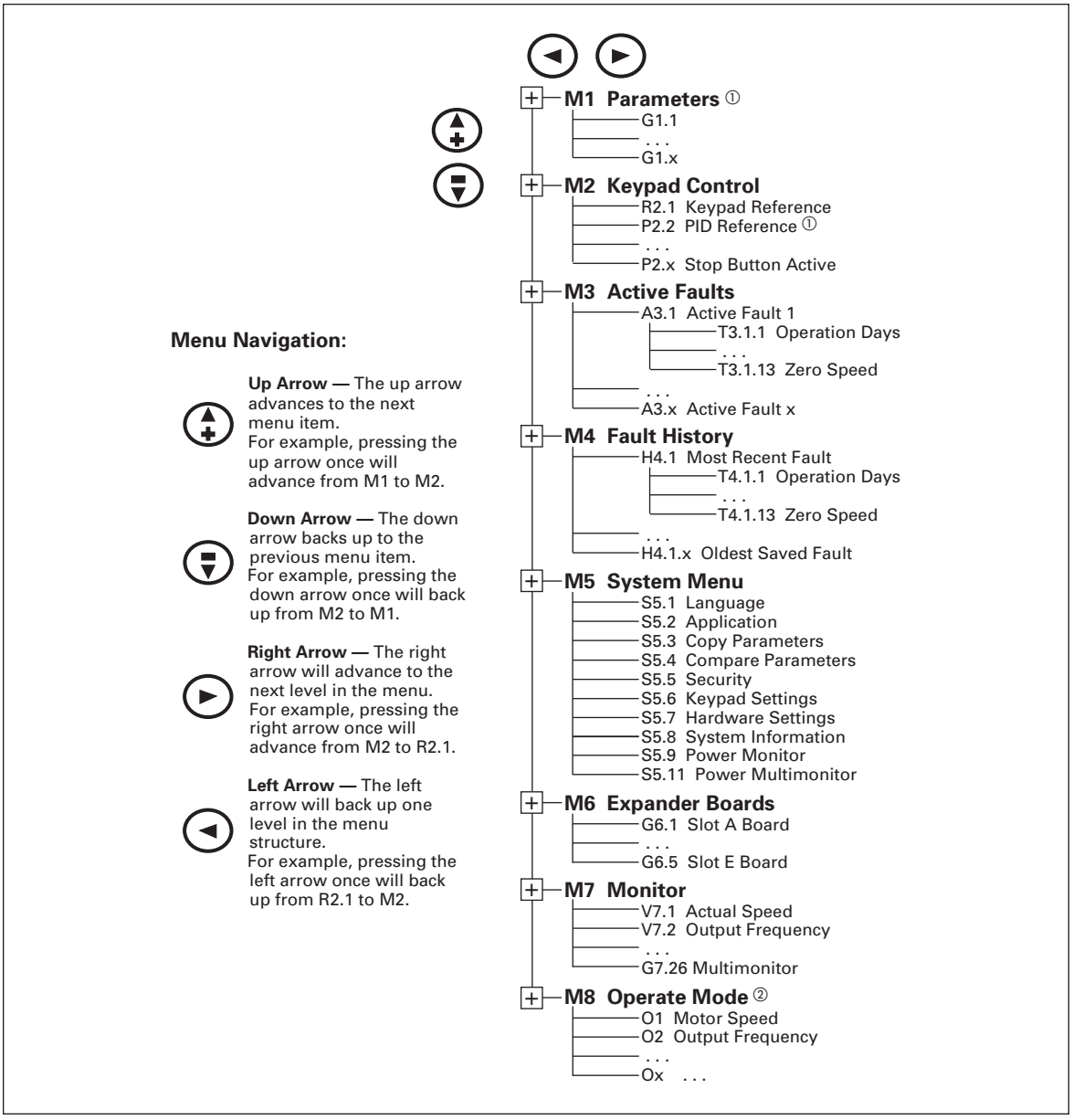

Menu Navigation:
Up Arrow — The up arrow advances to the next menu item. For example, pressing the up arrow once will advance from M1 to M2.
Down Arrow — The down arrow backs up to the previous menu item. For example, pressing the down arrow once will back up from M2 to M1.
Right Arrow — The right arrow will advance to the next level in the menu. For example, pressing the right arrow once will advance from M2 to R2.1.
Left Arrow — The left arrow will back up one level in the menu structure. For example, pressing the left arrow once will back up from R2.1 to M2.
M1 Parameters ①
G1.1
. . .
G1.x
M2 Keypad Control
R2.1 Keypad Reference
P2.2 PID Reference ①
. . .
P2.x Stop Button Active
M3 Active Faults
A3.1 Active Fault 1
T3.1.1 Operation Days
. . .
T3.1.13 Zero Speed
. . .
A3.x Active Fault x
M4 Fault History
H4.1 Most Recent Fault
T4.1.1 Operation Days
. . .
T4.1.13 Zero Speed
. . .
H4.1.x Oldest Saved Fault
M5 System Menu
S5.1 Language
S5.2 Application
S5.3 Copy Parameters
S5.4 Compare Parameters
S5.5 Security
S5.6 Keypad Settings
S5.7 Hardware Settings
S5.8 System Information
S5.9 Power Monitor
S5.11 Power Multimonitor
M6 Expander Boards
G6.1 Slot A Board
. . .
G6.5 Slot E Board
M7 Monitor
V7.1 Actual Speed
V7.2 Output Frequency
. . .
G7.26 Multimonitor
M8 Operate Mode ②
O1 Motor Speed
O2 Output Frequency
. . .
Ox . . .

Figure 6-2: Main Menu Navigation

① Menu application dependent, See on **Figure 6-12** on **Page 6-6**.
② For navigation of Operate Menu (M8), see **Figure 6-12** on **Page 6-22**.

Parameter Menu (M1)

The Parameter Menu is a single or multi-level menu, depending on the application in use, arranged by the parameter group items. **Figure 6-3** illustrates this menu for a Pressure Control application. Parameters and parameter groups are explained in further detail in **Chapters 8 – 10**.

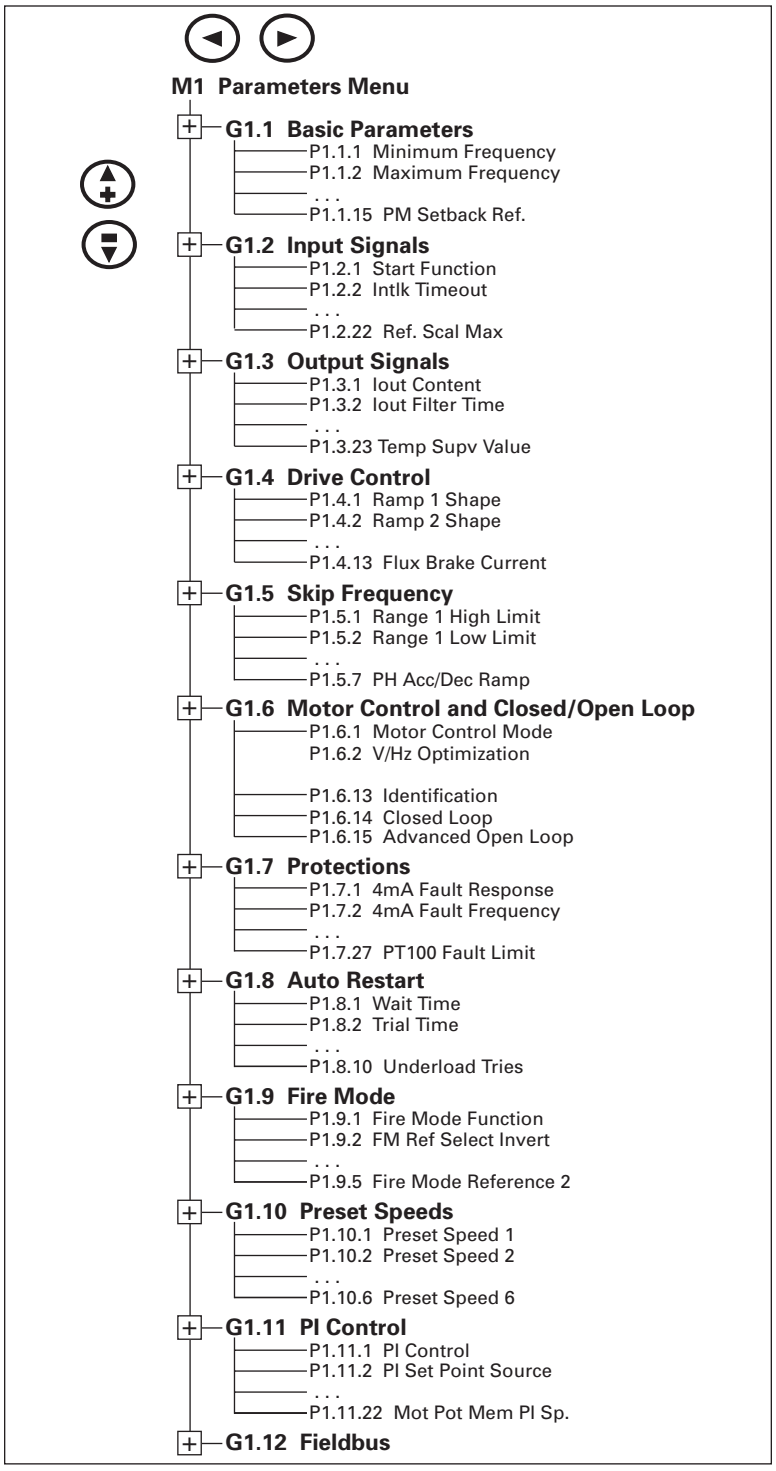


Figure 6-3: Parameter Menu Structure Example

Keypad Control Menu (M2)

In the Keypad Control Menu, you can set the frequency reference, choose the motor direction for keypad operation, and determine if the STOP button will be active at all times. See **Figure 6-4**.

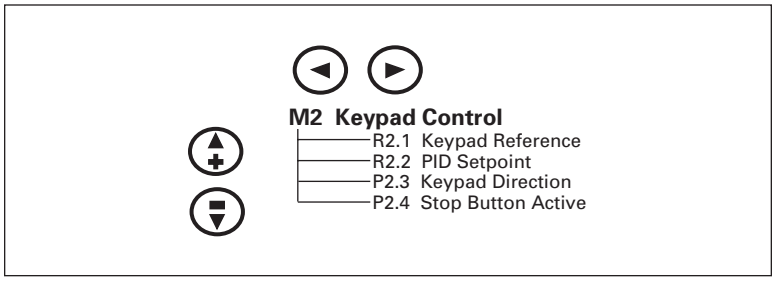


Figure 6-4: Keypad Control Menu

R2.1 Keypad Reference

Range: Min. Frequency — Max. Frequency
Units: Hertz
KEYPAD REFERENCE
This displays and allows the operator to edit the keypad frequency reference. A change takes place immediately. This reference value will not influence the output frequency unless the keypad has been selected as the active control place.

R2.2 PID Setpoint

Range: Default: Application Dependent
PID SETPOINT
PID regulators setpoint.

P2.3 Keypad Direction

Range: Forward, Reverse Default: Forward
KEYPAD DIRECTION
This allows the operator to change the rotation direction of the motor. This setting will not influence the rotation direction of the motor unless the keypad has been selected as the active control place.

P2.4 Stop Button Active

Range: Yes, No Default: Yes
STOPBUTTONACTIVE
By default, pressing the STOP button will **always** stop the motor regardless of the selected control place. If this parameter is set to **No**, the **STOP** button will stop the motor only **when the keypad has been selected as the active control place**.

Active Faults Menu (M3)

When a fault occurs, the drive stops. The sequence indication F1, the fault code, a short description of the fault and the fault type symbol will appear on the display. In addition, the indication FAULT or ALARM is displayed and, in case of a FAULT, the red LED on the keypad starts to blink. If several faults occur simultaneously, the sequence of active faults can be browsed with the Browser buttons. See **Figure 6-5**.

The active faults memory can store the maximum of 10 faults in sequential order of appearance. The fault remains active until it is cleared with either the STOP or RESET buttons or with a reset signal from the I/O terminal. Upon fault reset, the display will be cleared and will return to the same state it was in before the fault trip.

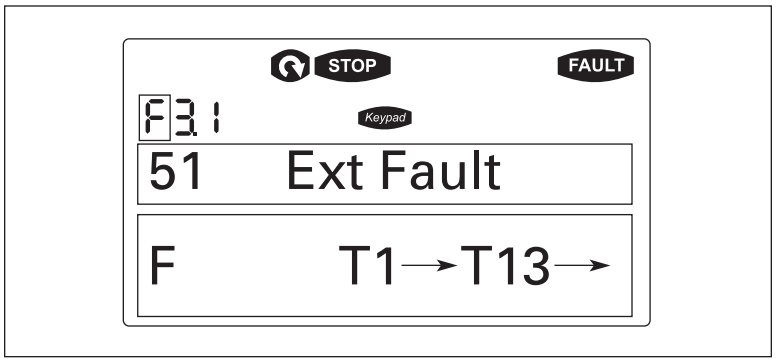


Figure 6-5: Active Fault Display Example

⚠ CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the drive, which could result in personal injury or equipment damage.

Fault Type

Range: A, F, AR, FT

FAULT TYPE

There are four different types of faults. These faults and their definitions are given in **Table 6-4**.

Table 6-4: Fault Types

Fault Type	Fault Name	Description
A	Alarm	This type of fault is a sign of an unusual operating condition. It does not cause the drive to stop, nor does it require any special actions. The "A fault" remains in the display for about 30 seconds.
F	Fault	An "F fault" is a kind of fault that makes the drive stop. Actions need to be taken in order to restart the drive.
AR	Auto-Restart Fault	If an "AR fault" occurs the drive will also stop immediately. The fault is reset automatically and the drive tries to restart the motor. If the restart is not successful, a fault trip (FT) occurs.
FT	Fault Trip	If the drive is unable to restart the motor after an AR fault, an FT fault occurs. The effect of the "FT fault" is the same as that of the F fault — the drive is stopped.

Fault Code

Range: 1 – 54

Fault codes indicate the cause of the fault. A list of fault codes, their descriptions, and possible solutions can be found in **Appendix B — Fault and Warning Codes**.

Fault Time Data Record

Range: T.1 – T.13

In this menu, important data recorded at the time the fault is available. This feature is intended to help the user or the service person to determine the cause of fault. **Table 6-5** indicates the information that is recorded.

Table 6-5: Fault Time Data

Data	Units	Description
T.1 ①	D	Counted operation days (Fault 43: Additional code)
T.2 ①	hh:mm:ss (d)	Counted operation hours (Fault 43: Counted operation days)
T.3	Hz hh:mm:ss	Output frequency (Fault 43: Counted operation hours)
T.4 T.5 T.6 T.7 T.8	A V % % V	Motor current Motor voltage Motor power Motor torque DC bus voltage
T.9 T.10 T.11 T.12 T.13	°C — — — —	Unit temperature Run status Direction Warnings Zero speed

①Real time record.

If real time is set, T.1 and T.2 will appear as follows:

T.1	yyyy-mm-dd	Counted operation days (Fault 43: Additional code)
T.2	hh:mm:ss.sss	Counted operation hours (Fault 43: Counted operation days)

Fault History Menu (M4)

All faults are stored in the Fault History Menu, which can be viewed by using the Browser buttons. Additionally, the Fault time data record pages are accessible for each fault as in the Active Faults Menu described above. See **Figure 6-6**.

The drive's memory can store a maximum of 30 faults, in the order of appearance. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest fault from the memory.

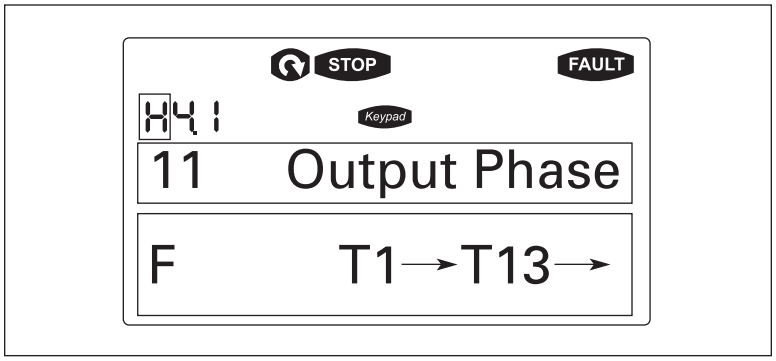


Figure 6-6: Sample Fault History Display

Note: Pressing the ENTER button for 3 seconds will clear the entire fault history.

System Menu (M5)

The controls associated with the general use of the drive, such as application selection, customized parameter sets or information about the hardware and software are located in the System Menu. Password protection can be activated by parameter ***S5.5.1***.

Descriptions of the system menu parameters are illustrated in **Figure 6-7**.

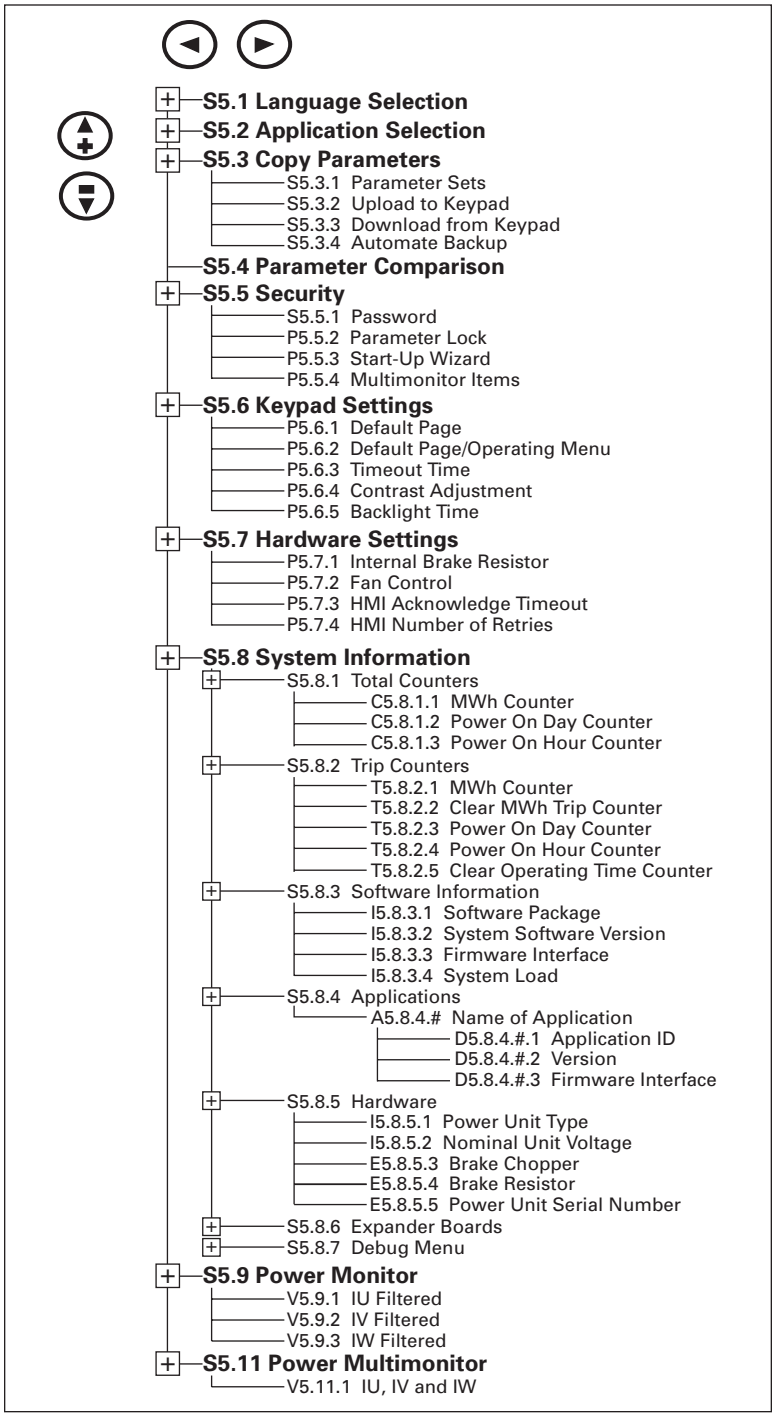


Figure 6-7: System Menu Structure

System Menu Parameters

S5.1 Language Selection

Range: English (Spanish①, French①, Portuguese①) Default: English

LANGUAGE

This parameter offers the ability to control the drive through the keypad in the language of your choice. Currently available language: English.

① Available in the future.

S5.2 Application Selection

Default: BAC Temp F

APPLICATION

This parameter sets the active application.

When changing applications, you will be asked if you want the parameters of the new application to be uploaded to the keypad. If you wish to load the new application parameters, press the ENTER button. Pressing any other button saves the parameters of the previously used application in the keypad.

System Menu Copy Parameter Options (S5.3)

The copy parameter function is used when the operator wants to copy one or all parameter groups from one drive to another. All the parameter groups are first uploaded to the keypad, the keypad is connected to another drive and then the parameter groups are downloaded to it (or possibly back to the same drive).

Note: Before any parameters can successfully be copied from one drive to another, the drive must be stopped before the parameters are downloaded to it.

S5.3.1 Parameter Sets

PARAMETER SETS

This parameter allows you to reload the factory default parameter values, and to store and load two customized parameter sets.

S5.3.2 Upload to Keypad

UP TO KEYPAD

This function uploads all existing parameter groups to the keypad.

S5.3.3 Download from Keypad

Range: 0 – 3 Default: 0 (All parameters)

DOWN FROM KEYPAD

This function downloads one or all parameter groups from the keypad to the drive.

0 All parameters
1 All, no motor
2 Application parameters

S5.3.4 Automatic Backup

Range: Yes, No Default: Yes

AUTO.BACKUP

This parameter activates and deactivates the parameter backup function. When the parameter backup function is activated, the keypad makes a copy of the parameters and settings in the currently active application. When applications are changed, you will be asked if you wish the parameters of the **new** application to be uploaded to the keypad. For this to happen, press the ENTER button. If you wish to keep the copy of the parameters of the **previously used** application saved in the keypad, press any other button.

Note: Parameters saved in the parameter settings of S5.3.1 will be deleted when applications are changed. If you want to transfer the parameters from one application to another, you have to upload them to the keypad first.

System Menu Parameter Comparison Options (S5.4)

S5.4 Parameter Comparison

PARAMETER COMPARISON

With the Parameter Comparison function, you can compare the actual parameter values to the values of your customized parameter sets and those loaded to the control keypad.

The actual parameter values are first compared to those of the customized parameter Set1. If no differences are detected, a "0" is displayed on the lowermost line of the keypad.

If any of the parameter values differ from those of the Set1 parameters, the number of the deviations is displayed together with symbol P (e.g. P1 ➠ P5 = five deviating values).

By pressing the right arrow button once again you will see both the actual value and the value it was compared to. In this display, the value on the Description line (in the middle) is the default value, and the one on the value line (lowermost line) is the edited value. You can also edit the actual value by pressing the Right Arrow button.

Actual values can also be compared to Set2, Factory Settings and the Keypad Set values.

Security Menu Parameter Options (S5.5)

Note: The Security submenu is protected with a password. Store the password in a safe place.

S5.5.1 Password

Range: 0 – 65535 Default: 0

PASSWORD

The application selection can be protected against unauthorized changes with the Password function. When the password function is enabled, the user will be prompted to enter a password before application changes, parameter value changes, or password changes. Password can also be used to prevent user from exiting the operating menu.

By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 65535. The password will be activated after the ***Timeout Time*** has expired.

To deactivate the password, reset the parameter value to 0. Backdoor password is 2277.

P5.5.2 Parameter Lock

Range: ChangeEnable, ChangeDisabl Default: ChangeEnable

PARAMETER LOCK

This function allows the user to prohibit changes to the parameters. If the parameter lock is activated the text *LOCKED* will appear on the display if you try to edit a parameter value.

Note: This function does not prevent unauthorized editing of parameter values.

P5.5.3 Start-Up Wizard

Range: Yes, No Default: No

START-UP WIZARD

The Start-Up Wizard facilitates commissioning the drive. If selected active, the Start-Up Wizard prompts the operator for the language and application desired and then advances through the start-up parameter list. After completion it allows the user to repeat the Start-Up Wizard or return to the default page, the Operate Menu. The Start-Up Wizard is always active for the initial power up of the drive.

This feature can also be selected by pressing the STOP/RESET button for 5 seconds. Display will then show "Start-Up Wizard Activated". Unit must then be powered down and "SUW" will be displayed on powerup.

P5.5.4 Multimonitor Items

Range: ChangeEnable, ChangeDisabl Default: ChangeEnable

MULTIMON.ITEMS

The keypad display can display three actual monitored values at the same time. This parameter determines if the operator is allowed to replace the values being monitored with other values.

Keypad Settings (S5.6)

There are five parameters (***Default Page*** to ***Backlight Time***) associated with the keypad operation:

P5.6.1 Default Page

Range: 0 – 8 Default: 0

DEFAULT PAGE

This parameter sets the view the display shows when entering the Programming Mode. See **Figure 6-2** on **Page 6-5**.

0,1 M1 Programming
2 M2 Keypad Control
3 M3 Active Faults
4 M4 Fault History
5 M5 System Menu
6 M6 Expander Boards
7 M7 Monitor
8 M8 Operate Mode

P5.6.2 Default Page in the Operating Menu

DEFAULT PAGE/OM

Here you can set the location in the Operating menu to which the display automatically moves as the set ***Timeout Time*** expires, or when the keypad power is switched on. See setting of ***Default Page*** parameter above.

P5.6.3 Timeout Time

Range: 0 – 65,535 Default: 60
Units: Seconds

TIMEOUT TIME

The ***Timeout Time*** setting defines the time after which the keypad display returns to the ***Default Page***.

Note: If the ***Default Page*** value is 0 the ***Timeout Time*** setting has no effect.

P5.6.4 Contrast Adjustment

CONTRAST ADJUSTMENT

If the display is not clear, you can adjust the keypad contrast with this parameter.

P5.6.5 Backlight Time

Range: 1 – 65,535 or Forever Default: 10
Units: Minutes

BACKLIGHT TIME

This parameter determines how long the backlight stays on before going out. You can select any time between 1 and 65,535 minutes or “Forever”.

Hardware Settings (S5.7)

The Hardware Settings submenu (S5.7) provides parameters for setting information on Internal brake resistor connection, Fan control, Keypad acknowledge timeout and Keypad retries.

P5.7.1 Internal Brake Resistor Connection

Range: Connected – Not Connected — Default: Not Connected

INTERNBRAKERES

With this function you tell the drive whether the internal brake resistor is connected or not.

If your drive has an internal brake resistor, the default value of this parameter is "Connected". However, if it is necessary to increase braking capacity by installing an external brake resistor, or if the internal brake resistor is disconnected, it is advisable to change the value of this function to "Not Connected" in order to avoid unnecessary fault trips.

Note: The brake resistor is available as an option for all drives. It can be installed internally in frame sizes FR4 to FR6.

P5.7.2 Fan Control

Range: Continuous, Temperature, First Start, Calc Temp — Default: Continuous

FAN CONTROL

This function sets the control method of the drive's cooling fan.

1 Continuous – fan runs continuously.

2 Temperature – based on the temperature of the unit. The fan is switched on automatically when the heatsink temperature reaches 60°C. The fan receives a stop command when the heatsink temperture falls to 55°C. The fan runs for about a minute after receiving the stop command or switching on the power, as well as after changing the value from "Continuous" to "Temperature".

3 First Start – after power-up the fan is stopped until the RUN command is given and then fan runs continuously. This is mainly made for common DC-bus systems to prevent cooling fans to load charging resistors on power-up moment.

4 Calc Temp – starting of cooling fan is based on calculated IGBT temperature. When IGBT temp = 40°C, fan starts and when temp falls down to 30°C, fan stops.

Note: The fan runs continuously, regardless of this setting, when the drive is in RUN state.

P5.7.3 Keypad Acknowledge Timeout

Range: 200 – 5,000 Default: 200
Units: mseconds
KEYPAD ACK TIMEOUT
This function allows the user to change the timeout of the Keypad acknowledgement time.

Note: If the drive has been connected to a PC with a serial cable, the default values of ***Keypad Acknowledge Timeout*** and ***Number of Retries to Receive Keypad Acknowledgement*** must not be changed.

If the drive has been connected to a PC via a modem and there is delay in transferring messages, the value of ***Keypad Acknowledge Timeout*** must be set according to the delay as follows:

Example:

- Transfer delay between the drive and the PC is found to be = 600 ms
- The value of Keypad Acknowledge Timeout is set to 1200 ms (2 x 600, sending delay + receiving delay)
- The corresponding setting is then entered in the [Misc] section of the file NCDrive.ini:

  Retries = 5

  AckTimeOut = 1200

  TimeOut = 5000

It must also be considered that intervals shorter than the ***Keypad Acknowledge Timeout*** time cannot be used in drive monitoring.

P5.7.4 Number of Retries to Receive Keypad Acknowledge-ment

Range: 1 – 10 Default: 5
KEYPAD RETRY
With this parameter you can set the number of times the drive will try to receive an acknowledgement when it has not been received within the acknowledgement time (***Keypad Acknowledge Timeout***) or if the received acknowledgement is faulty.

System Information (S5.8)

This section contains hardware and software information as well as operation information.

S5.8.1 Total Counters

TOTAL COUNTERS
In the ***Total Counters*** page you will find information related to the drive operating times, i.e. the total numbers of MWh, operating days and operating hours. See **Table 6-6**.

Unlike the counters for the ***Trip Counters***, these counters cannot be reset.

Note: The Power On time counters, days and hours, operate whenever power is applied to the drive.

Table 6-6: Total Counters

Number	Name	Description
C5.8.1.1	MWh counter	Megawatt hours total operation time counter
C5.8.1.2	Power On day counter	Number of days the drive has been supplied with power
C5.8.1.3	Power On hour counter	Number of hours the drive has been supplied with power

S5.8.2 Trip Counters

TRIP COUNTERS

The ***Trip Counters*** are counters whose values can be reset to zero. The resettable counters are shown in **Table 6-7**.

Table 6-7: Trip Counters

Number	Name	Description
T5.8.2.1	MWh counter	Megawatts hours since last reset
P5.8.2.2	Clear MWh counter	Resets megawatts hours counter
T5.8.2.3	Power On day counter	Number of days the drive has been run since the last reset
T5.8.2.4	Power On hour counter	Number of hours the drive has been run since the last reset
P5.8.2.5	Clr Optime cntr	Resets the operating day and hour counters

Note: The ***Trip Counters*** operate only when the motor is running.

S5.8.3 Software Information

SOFTWARE

The Software information page includes information on the following software related topics:

Table 6-8: Software Information

Number	Name	Description
I5.8.3.1	Software package	SVX00031V016 or later
I5.8.3.2	System software version	11.69.8170 or later
I5.8.3.3	Firmware interface	4.53 or later
I5.8.3.4	System load	XX % Microprocessor loading

S5.8.4 Application Information

APPLICATIONS

The Application information page includes information on not only the application currently in use but also all other applications loaded into the drive. The information available is shown in **Table 6-9**. Note that the "x" in the table refers to the sequential number of the application in the list.

Table 6-9: Application Information

Name	Content
A5.8.4.x	Application name
D5.8.4.x.1	Application ID
D5.8.4.1.2	Version
D5.8.4.2.3	Firmware interface

S5.8.5 Hardware Information

HARDWARE

The Hardware information page provides information on the following hardware-related topics:

Table 6-10: Hardware Information

Number	Content
I5.8.5.1	Power unit serial number
I5.8.5.2	Nominal voltage of the unit
E5.8.5.3	Brake chopper
E5.8.5.4	Brake resistor
E5.8.5.5	Serial Number

S5.8.6 Expander Board Information

EXPANDER BOARDS

This parameter and its sub-items provide information about the basic and option boards plugged into the control board as shown in **Table 6-11**. Note that the "x" in the table refers to the sequential number of the slot, with slot A being "1" and slot E being "5".

Table 6-11: Expander Board Information

Number	Content
E5.8.6.x	Slot "x" board identification
E5.8.6.x.1	Operating state
E5.8.6.x.2	Program version

S5.8.7 Debug Menu

DEBUG

This menu is meant for advanced users and application designers. Contact the factory for any assistance needed.

Power Monitor (S5.9)

Table 6-12: Power Monitor

Number	Name	Content
V5.9.1	IU Filtered	U output phase measured current in amps
V5.9.2	IV Filtered	V output phase measured current in amps
V5.9.3	IW Filtered	W output phase measured current in amps

Power Multimonitor (S5.11)

Table 6-13: Power Multimonitor

Number	Name	Content
V5.11.1	Power Multimonitor	All 3 output phases displayed on one screen

Expander Board Menu (M6)

The Expander Board Menu makes it possible for the user to:

- see what expander boards are connected to the control board, and
- access and edit the parameters associated with the expander board.

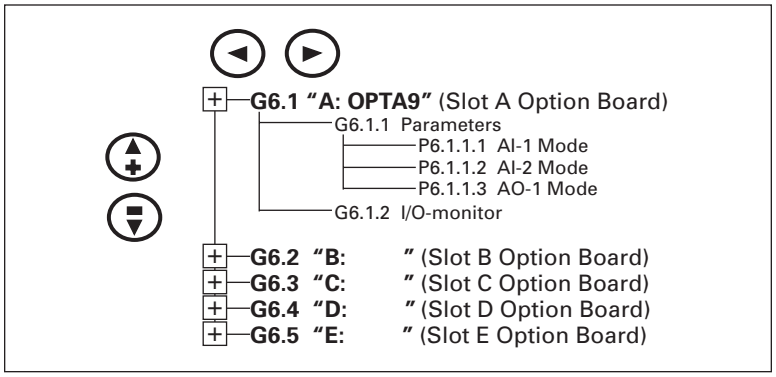

G6.1 "A: OPTA9" (Slot A Option Board)
G6.1.1 Parameters
P6.1.1.1 AI-1 Mode
P6.1.1.2 AI-2 Mode
P6.1.1.3 AO-1 Mode
G6.1.2 I/O-monitor
G6.2 "B: " (Slot B Option Board)
G6.3 "C: " (Slot C Option Board)
G6.4 "D: " (Slot D Option Board)
G6.5 "E: " (Slot E Option Board)

Figure 6-8: Expander Board Menu Structure

Example of Expander Board Parameters for Option Board A9

P6.1.1.1 AI-1 Mode
Range: 1 – 5 Default: 3
AI-1 MODE
Analog Input 1 input options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.2 AI-2 Mode
Range: 1 – 5 Default: 1
AI-2 MODE
Analog Input 2 input options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.3 AO-1 Mode
Range: 1 – 4 Default: 1
AO-1 MODE
Analog Output 1 output options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V

Monitoring Menu (M7)

The Monitoring Menu items are meant for viewing parameter values during operation. Monitored values are updated every 0.3 sec. Monitored items are identified by item numbers V7.1 to V1.xx, where "xx" varies by application. **Table 6-14** provides an example of the monitored values for the **Pressure Control** application.

Note: Monitored parameters are not editable from this menu. See Parameter Menu [M1] to change parameter values.

Table 6-14: Monitoring Menu Items — Pressure Control Application Example

Code	Signal Name	Unit	ID	Description
V7.1	Fan Speed	Hz	1	Output frequency to motor
V7.2	PID Setpoint	①	20	PID setpoint AD
V7.3	PID Actual Value or Sensor Input	①	21	PID actual value
V7.4	Fan Speed	%	23	PID output in %
V7.5	PID Error	①	22	Error between PID actual and PID Setpoint
V7.6	Fan Reference	%	1520	Motor reference in %
V7.7	Frequency Reference	Hz	25	Frequency Ref
V7.8	Motor Speed	rpm	2	Calculated motor speed in rpm
V7.9	Motor Current	A	3	Motor current
V7.10	Motor Torque	%	4	Calculated torque as a % of nominal torque
V7.11	Motor Power	%	5	Calculated motor shaft power
V7.12	Motor Voltage	VAC	6	Calculated motor V
V7.13	DC Bus Voltage	VDC	7	DC bus voltage
V7.14	Unit Temperature	°C	8	Heatsink temperature
V7.15	Motor Temperature	%	9	Calculated motor temperature
V7.16	Analog Input 1	V	13	Analog Input 1
V7.17	Analog Input 2	mA	14	Analog Input 2
V7.18	DIN1 – DIN3 Status	OFF/ON	15	Status of DIN1 thru DIN3
V7.19	DIN4 – DIN6 Status	OFF/ON	16	Status of DIN4 thru DIN6
V7.20	DIN Status		1904	
V7.21	DO1, RO1, RO2 Status	OFF/ON	17	Digital and relay output status
V7.22	RO3, RO4, RO5 Status		1898	
V7.23	Relay Output Status		1773	
V7.24	Analog Iout	mA	26	Analog output AO1
V7.25	PT100 temperature	°C	42	Highest temperature of used inputs, needs option board (OPTB8)
G7.26	Multimonitor	—	—	Displays three selectable monitoring values

① AD = Application Dependent.

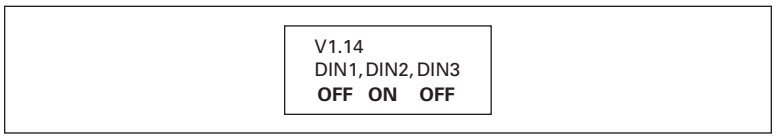


Figure 6-9: Digital Inputs — DIN1, DIN2, DIN3 Status

Figure 6-10: Digital Inputs — DIN4, DIN5, DIN6 Status

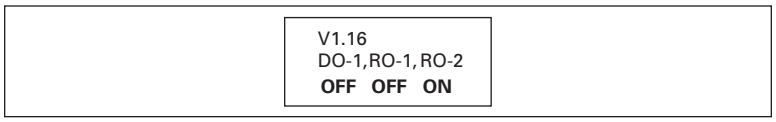


Figure 6-11: Digital and Relay Outputs — DO-1, RO-1, RO-2 Status

Multimonitor (G7.23)

This parameter allows the viewing and selection (if allowed by System menu parameter option, P5.5.4) of three simultaneously monitored items from the Monitored Menu Items shown in **Table 6-14**. Use the right arrow key to select the item to be modified and then the up or down arrow keys to select the new item. Press the ENTER key to accept the change.

Operate Menu (M8)

The Operate Menu provides a easy-to-use method of viewing key numerical Monitoring Menu items. Some applications also support the setting of reference values in this menu. The items displayed vary by application. **Table 6-15** is an example for the Temperature Fahrenheit Control application.

Table 6-15: Operate Menu Items — Temperature Control Application Example

Index	Signal Name	Unit	Description
O1	Fan Speed	Hz	
O2	Temperature Setpoint	°F/°C/%	
O3	Leaving Water Temp.	°F/°C/%	
O4	Fan Speed	%	Motor speed in %
O5	Temperature Error	°F/°C/%	
O6	Fan Ref %	%	
O7	Freq Reference	Hz	
O8	Motor Speed	rpm	
O9	Motor Current	A	Calculated motor current
O10	Motor Torque	%	Calculated motor torque
O11	Motor Power	V	Calculated motor power
O12	Motor Voltage	VAC	Calculated motor voltage
O13	DC-Bus Voltage	VDC	Measured DC bus voltage
O14	Unit Temperature	°C	Heatsink temperature
O15	Motor Temperature	%	Calculated motor temperature based on the motor nameplate information and actual motor load
O16	Multimonitor		The 3 monitoring variables or parameters present in the Operate Menu must be programmed in the Monitor Menu M7

The Operate Menu is navigated by using the left and right arrow buttons. If a reference level is available for setting, the up and down arrow buttons adjust the value. To exit the Operate Menu and access the other menus, press the ENTER button for 2 seconds. While in the other menus, if there is no keypad activity, the display will return to the Operate Menu after one minute or whatever time is programmed in P5.6.3 (Timeout Time). **Figure 6-12** illustrates the Operate Menu button function.

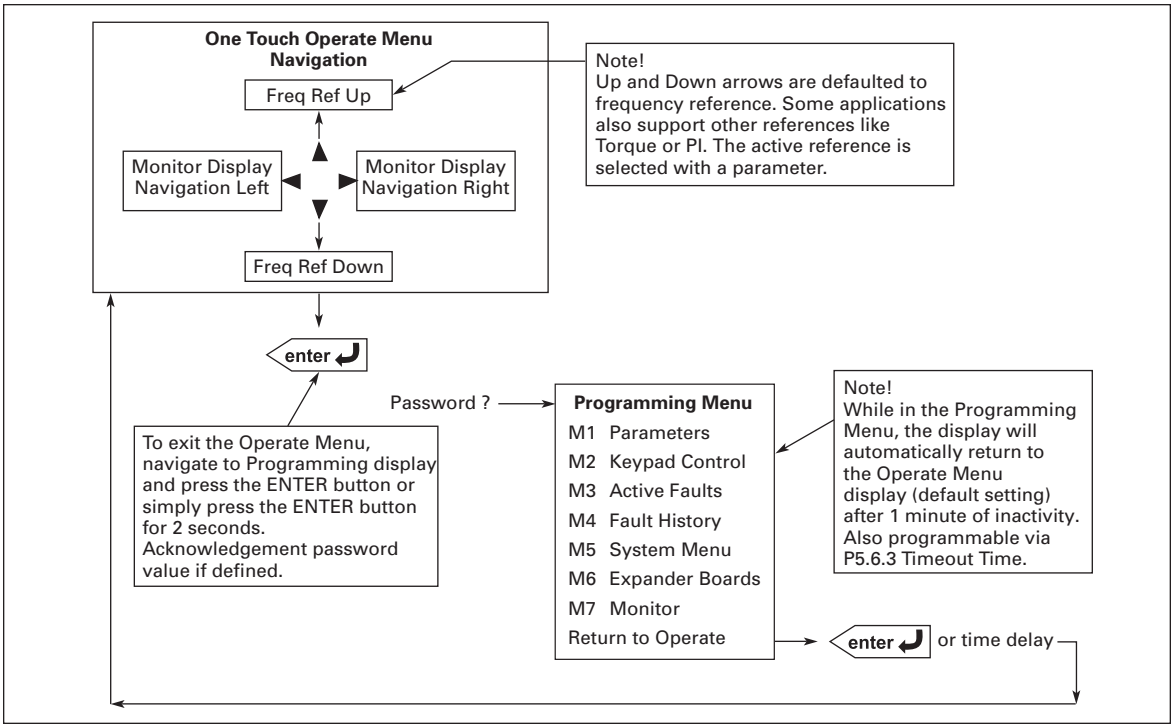

One Touch Operate Menu Navigation
Freq Ref Up
Monitor Display Navigation Left
Monitor Display Navigation Right
Freq Ref Down
Note!
Up and Down arrows are defaulted to frequency reference. Some applications also support other references like Torque or PI. The active reference is selected with a parameter.
enter
Password ?
Programming Menu
M1 Parameters
M2 Keypad Control
M3 Active Faults
M4 Fault History
M5 System Menu
M6 Expander Boards
M7 Monitor
Return to Operate
Note!
While in the Programming Menu, the display will automatically return to the Operate Menu display (default setting) after 1 minute of inactivity. Also programmable via P5.6.3 Timeout Time.
enter
or time delay
To exit the Operate Menu, navigate to Programming display and press the ENTER button or simply press the ENTER button for 2 seconds. Acknowledgement password value if defined.

Figure 6-12: Operate Menu Navigation

August 2006

Chapter 7 — Start-Up

Safety Precautions

Before start-up, observe the following warnings and safety instructions.

⚠ WARNING

1. Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the BAC VFD is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.
2. When the BAC VFD is connected to the utility, the motor connections U (T1), V (T2), W (T3) and DC-link/brake resistor connections B–, B+ and R– are live even if the motor is not running.
3. Do not make any connections when the BAC VFD is connected to the utility line.
4. Do not open the cover of the BAC VFD immediately after disconnecting power to the unit, because components within the drive remain at a dangerous voltage potential for some time. Wait at least five minutes after the cooling fan has stopped and the keypad or cover indicators are dark before opening the BAC VFD cover.
5. The control I/O terminals are isolated from the utility potential, but relay outputs and other I/Os may have dangerous external voltages connected even if power is disconnected from the BAC VFD.
6. Before connecting to the utility, make sure that the cover of the BAC VFD is closed.

Sequence of Operation

Read and follow all safety precautions.

1. At installation ensure that:
   a. The BAC VFD and motor are connected to their grounds.
   b. The utility and motor cables are in accordance with the installation and connection instructions as detailed in **Chapter 3**.
   c. The control cables are located as far as possible from the power cables as detailed in **Chapter 4** and **Table 3-1**. Control cable shields must be connected to the protective ground. Make sure no wires make contact with any electrical components in the BAC VFD.
   d. The common input of digital input groups is connected to +24V or the ground of the I/O terminal supply or an external supply as detailed in **Chapter 4** and **Figure 4-6**.
2. Check the quality of the cooling air as detailed in **Chapter 2**, **Table 2-2**.
3. Check that moisture has not condensed inside the BAC VFD.
4. Check that all START/STOP switches connected to the I/O terminals are in the STOP state.
5. Connect the BAC VFD to the utility, and switch the power on.
6. Ensure that Group G1.1 parameters match the application by setting the following parameters to match the motor nameplate:
   - P1.1.7 = Nominal voltage of the motor
   - P1.1.8 = Nominal nameplate frequency of the motor
   - P1.1.9 = Nominal nameplate full-load speed of the motor
   - P1.1.10 = Motor nominal current
   - P1.1.11 = Service factor of the motor
   - P1.1.12 = Motor current limit
   - P1.1.14 = Motor power factor

   These parameter #'s are offset by 2 or 3 when using the Temp C and BAR applications due to the addition of the Siemens Apogee communication prototcol in the Temp F, PSIG and Remote Control applications.

7. Perform either Test A or Test B without the motor connected to the BAC VFD.

   Test A — Control from the Control Panel:

   - Apply input power to the BAC VFD.
   - Press HOA button until HAND LCD is flashing, then press ENTER.
   - Press the START button.
   - Go to the Operating Menu and check that the output frequency follows the reference as detailed in ***Reference Source Hand***.
   - Press the STOP/RESET button.

   Test B — Control from the I/O Terminals:

   - Apply input supply power to the BAC VFD.
   - Change control from the keypad to the I/O terminals. Press HOA button until AUTO LCD is flashing, then press ENTER. Start drive by closing DIN1.
   - Change the frequency reference, from where "StPt Source Auto" (P1.1.15) has been selected.
   - Check from the monitoring menu at the control panel that the output frequency follows the frequency reference.
   - Stop the drive by opening the start contact at DIN1.

Disconnect all power to the BAC VFD. Wait until the cooling fan on the unit stops and the indicators on the panel are not lit. If no keypad is present, check the indicators in the cover. Wait at least five more minutes for the DC bus to discharge. Connect the motor to the BAC VFD and check for correct motor rotation. If possible, perform a start-up test with the motor connected to the BAC VFD, but not connected to the process. If the BAC VFD must be tested with the motor connected to the process, perform the test under no-load or light load conditions.

Start-Up Wizard

Upon initial power up, the **Start-Up Wizard** guides the commissioner through the basic BAC VFD setup. The **Start-Up Wizard** may be set to function **upon power up** by setting parameter P5.5.3, or by pressing the STOP button for 5 seconds. The display will read "Startup Wizard" ACTIVATED after 5 seconds.

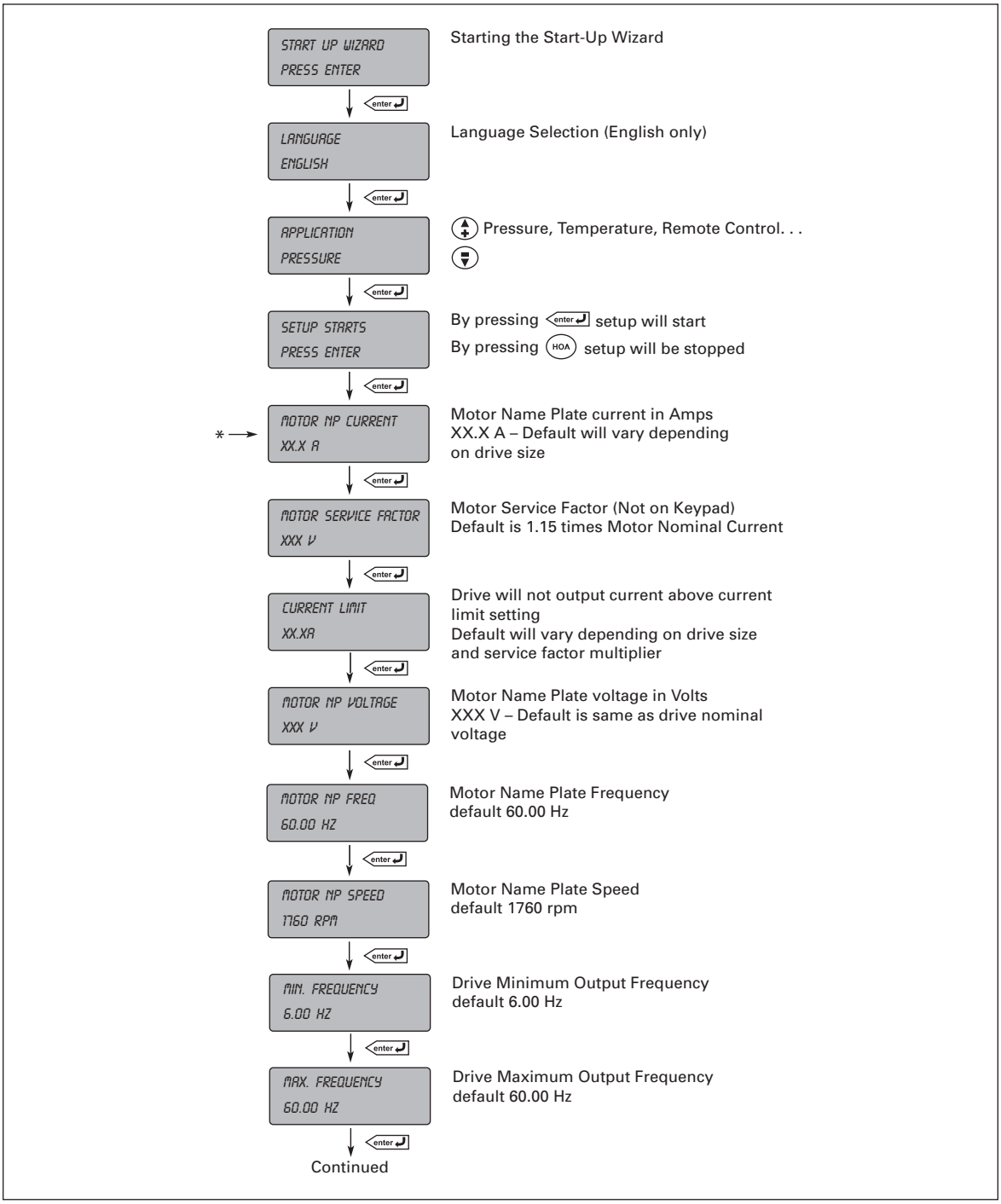


Figure 7-1: Start-Up Wizard Navigation (1 of 3)

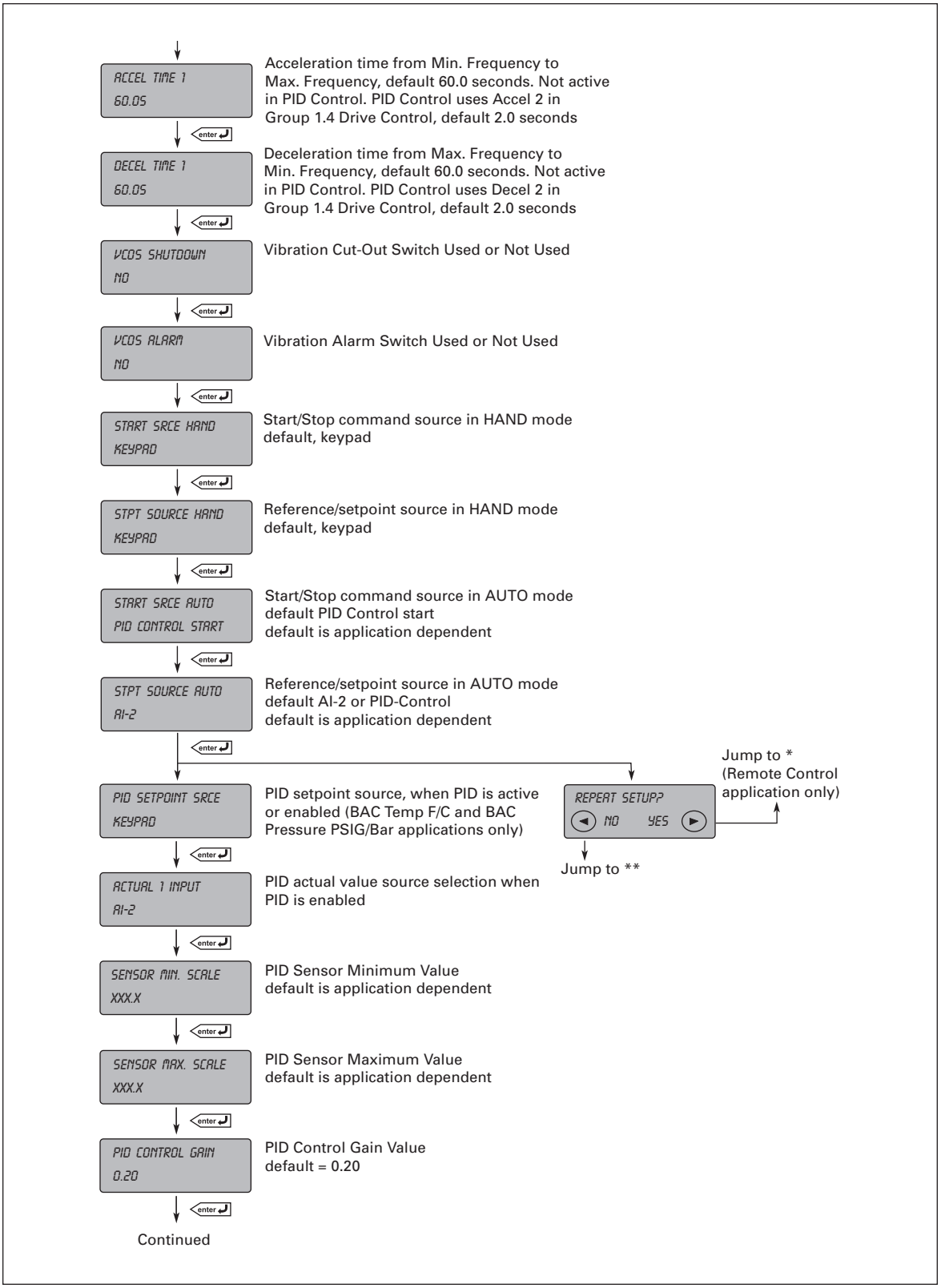

ACCEL TIME 1
60.0S
Acceleration time from Min. Frequency to Max. Frequency, default 60.0 seconds. Not active in PID Control. PID Control uses Accel 2 in Group 1.4 Drive Control, default 2.0 seconds
enter
DECEL TIME 1
60.0S
Deceleration time from Max. Frequency to Min. Frequency, default 60.0 seconds. Not active in PID Control. PID Control uses Decel 2 in Group 1.4 Drive Control, default 2.0 seconds
enter
VCOS SHUTDOWN
NO
Vibration Cut-Out Switch Used or Not Used
enter
VCOS ALARM
NO
Vibration Alarm Switch Used or Not Used
enter
START SRCE HAND
KEYPAD
Start/Stop command source in HAND mode default, keypad
enter
STPT SOURCE HAND
KEYPAD
Reference/setpoint source in HAND mode default, keypad
enter
START SRCE AUTO
PID CONTROL START
Start/Stop command source in AUTO mode default PID Control start default is application dependent
enter
STPT SOURCE AUTO
AI-2
Reference/setpoint source in AUTO mode default AI-2 or PID-Control default is application dependent
enter
Jump to * (Remote Control application only)
REPEAT SETUP?
NO
YES
Jump to **
PID SETPOINT SRCE
KEYPAD
PID setpoint source, when PID is active or enabled (BAC Temp F/C and BAC Pressure PSIG/Bar applications only)
enter
ACTUAL 1 INPUT
AI-2
PID actual value source selection when PID is enabled
enter
SENSOR MIN. SCALE
XXX.X
PID Sensor Minimum Value default is application dependent
enter
SENSOR MAX. SCALE
XXX.X
PID Sensor Maximum Value default is application dependent
enter
PID CONTROL GAIN
0.20
PID Control Gain Value default = 0.20
enter
Continued

Figure 7-2: Start-Up Wizard Navigation (2 of 3)

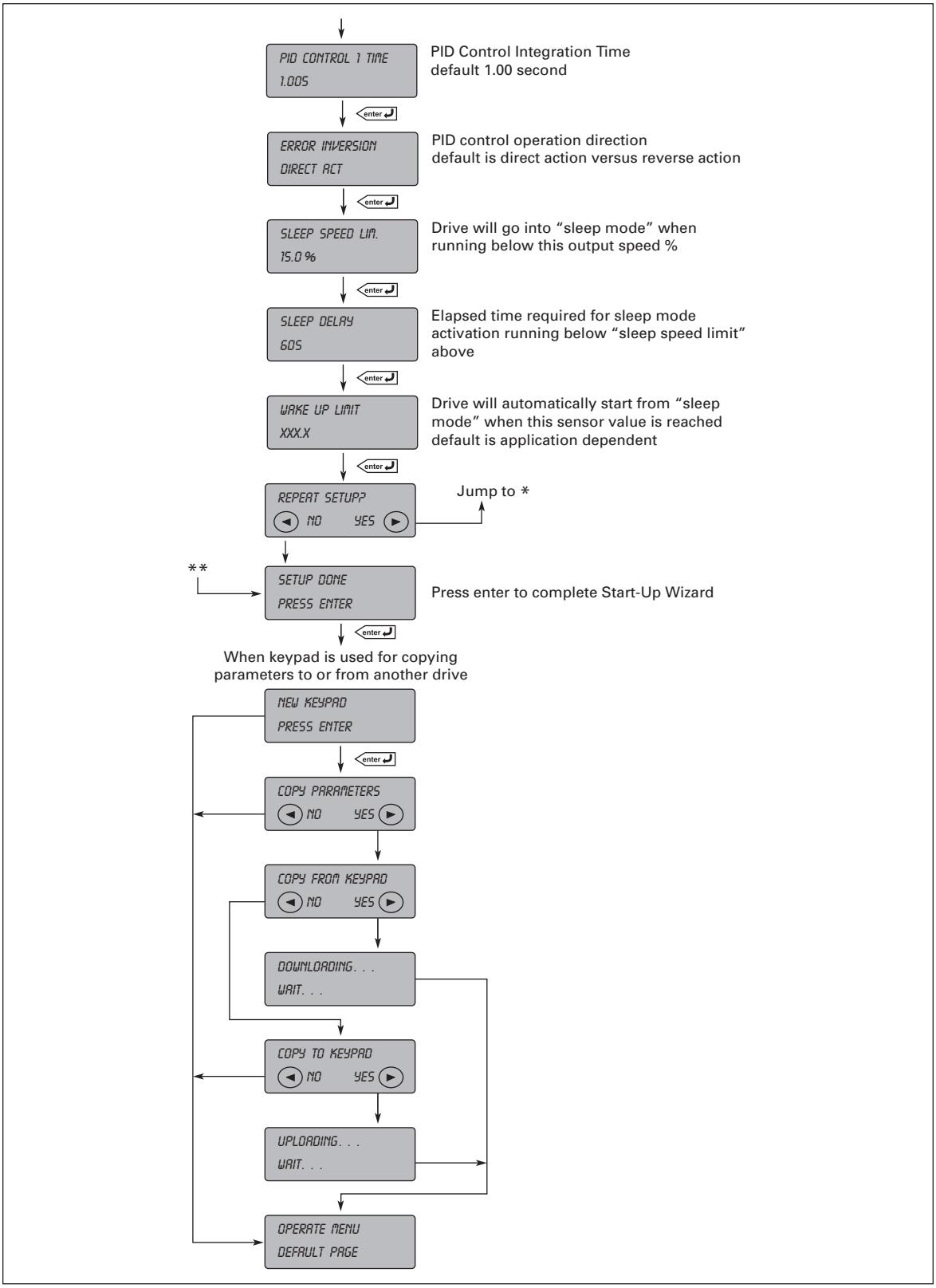


Figure 7-3: Start-Up Wizard Navigation (3 of 3)

August 2006

Chapter 8 — BAC Temp F/C Application (SVCHS302/SVCHS304)

Introduction

The BAC Temp F/C Application of the BAC VFD provides for two different control places – the PID controller and direct frequency reference. The PID control is selected by digital input DIN2 – DIN6 selection 16 or by enabling parameter P1.11.1 PID Control. PID can also be selected dependent on Hand or Auto control by selecting either P1.1.16 StPt Source Hand to "PID-Control" or P1.1.18 StPt Source Auto to "PID-Control." This allows PID operation in either Hand or Auto and direct frequency reference in the other. P1.11.1 PID control should be disabled for this operation.

The PID controller setpoint can be selected from the analog inputs, fieldbus, motor potentiometer, or by applying the control keypad reference. The PID controller actual value can be selected from the analog inputs, fieldbus, the actual values of the motor or through the mathematical functions of these.

The direct frequency reference can be used for the control without the PID controller and is selected from the analog inputs, fieldbus, motor potentiometer or keypad.

The Temperature Control Application is typically used to control leaving water temperature. In these applications, the Temperature Control Application provides a smooth control and an integrated measurement and control package where no additional components are needed.

- Digital inputs DIN2 through DIN6 and all outputs are freely programmable.

Additional functions:

- Analog input signal range selection
- Two frequency-limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection (Programmable action: off, warning, fault)
- Motor underload protection
- Input and output phase supervision
- Sum point frequency addition to PID output
- Use of the PID controller from control places I/O B, the keypad and the fieldbus
- Easy Change Over function
- Sleep function

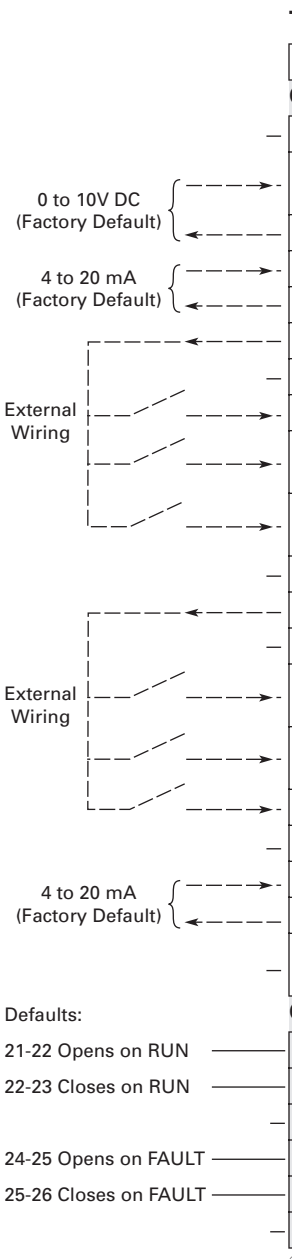
Details of the parameters shown in this section are available in **Chapter 11** of this Manual, listed by parameter ID number.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Control Input/Output

Table 8-1: BAC Temp F/C Application Default I/O Configuration

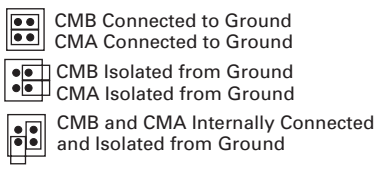
Terminal		Signal	Description
OPTA9			
1	+10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI-1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI-1-	I/O Ground	Ground for reference and controls
4	AI-2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI-2-		
6	+24V	Control voltage output	Voltage for switches, etc. (max 0.1A)
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start/Stop Control	Contact closed = Start
9	DIN2	External fault input (programmable)	Contact closed = Fault Contact open = No fault
10	DIN3	Fault reset (programmable)	Contact closed = Fault reset
11	CMA	Common for DIN1 – DIN3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Vibration Cutout Alarm (programmable)	Contact open = Alarm ①
15	DIN5	Vibration Cutout Fault (programmable)	Contact open = Fault ②
16	DIN6	Overload Relay Fault	Contact closed = Fault
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO-1+	Motor Speed Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO-1-		
20	DO-1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO-1	Relay output 1 RUN	Programmable
22	RO-1		
23	RO-1		
24	RO-2	Relay output 2 FAULT	Programmable
25	RO-2		
26	RO-2		



① Programmed from Start-Up Wizard or from Parameter P1.1.18 or selection 22, P1.2.6 VibAlmOpen.
② Programmed from Start-Up Wizard or from Parameter P1.1.17 or selection 22, P1.2.7 Vib Fault Open.

Note: For information on jumper selections, see **Page 4-5**.

X3 Jumper Setting — CMA and CMB Grounding


CMB Connected to Ground
CMA Connected to Ground
CMB Isolated from Ground
CMA Isolated from Ground
CMB and CMA Internally Connected
and Isolated from Ground

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Parameter Lists

On the following pages, you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 11**.

Column explanations:

Code = Location indication on the keypad; shows the operator the present parameter number
Parameter = Name of parameter
Min. = Minimum value of parameter
Max. = Maximum value of parameter
Unit = Unit of parameter value; given if available
Default = Value preset by factory
ID = ID number of the parameter for reference to **Chapter 11**

Basic Parameters — M1 → G1.1

Table 8-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.1	Min Frequency	0.00	Max Frequency	Hz	6.00	101	Min. output frequency
P1.1.2	Max Frequency	FreqMin	320.00	Hz	60.00	102	Max. output frequency
P1.1.3	Accel Time 1	0.1	3000.0	s	60.0	103	Time from min. frequency to max. frequency
V1.1.4 ①	Accel Time 1	0.1	3000.0	s	60.0	1690	Time from min. frequency to max. frequency
P1.1.5	Decel Time 1	0.1	3000.0	s	60.0	104	Time from max. frequency to min. frequency
V1.1.6 ①	Decel Time 1	0.1	3000.0	s	60.0	1691	Time from max. frequency to min. frequency
P1.1.7	Motor Nom Voltg	180	690	V	460	110	Motor nominal voltage in volts
P1.1.8	Motor Nom Freq	8.00	320.00	Hz	60.00	111	Motor nominal frequency
P1.1.9	Motor Nom Speed	24	20000	rpm	1760	112	Motor nominal speed in rpm
P1.1.10	Motor Nom Currnt	Motor CurrentMin	Motor CurrentMax	A	Varies	113	Motor nominal current
P1.1.11	Motor Service Factor	0.00	2.00	x	1.15	1685	Motor service factor. This value is multiplied by the motor nominal current to set the current limit.
P1.1.12	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	107	Output current limit
V1.1.13 ①	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	1624	Output current limit
P1.1.14	Power Factor	0.30	1.00		0.85	120	Motor Cos Phii or power factor

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.15	Start Srce Hand	1	3		1	171	Parameter for local start/stop control location. Default = Keypad **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire
P1.1.16	Setpoint Source Hand	0	5		2	173	Local frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer **5** = PID controller output
P1.1.17	Start Srce Auto	1	4		2	172	Parameter for remote start/stop control location: Default = DIN1 start **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire **4** = Fieldbus
P1.1.18	Setpoint Source Auto	0	5		5	174	Remote frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer **5** = PID controller output
P1.1.19	PM Setback Ref.	0.0	100.0	%	30.0	1500	PM setback speed reference (% of max. frequency) Default = 30.0%
P1.1.20	VCOS Shutdown	No	Yes	–	No	1837	VCOS Vibration cutout switch for drive fault. ②
P1.1.21	VCOS Alarm	No	Yes	–	No	1838	VCOS Vibration cutout alarm switch. ②

① This selection can be used along with a constant "start" signal if automatic restart is desired after a power cycle.

② These two parameters exist in the Start-Up Wizard. When selecting either "no" or "yes", you force P1.2.6 (Slot A, DIN4) or P1.2.7 (Slot A, DIN5) for either selection 21 "no" Vibration Cutout (closed contact) or selection 22 "yes" Vibration Cutout (open contact). If P1.2.6 or P1.2.7 digital inputs are programmed for anything other than the Vibration Cutout, then these two parameters should not be changed, otherwise they will force the selections for DIN4 or DIN5 to "21" or "22".

August 2006

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Input Signals — M1 → G1.2

Table 8-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.1	Start Function	0	3		0	1501	Start Function: **0** = Normal start from I/O without interlockings. **1** = Interlocked start from I/O. One of the digital/relay outputs must be programmed to value 27 (Interlock), and one of the digital inputs must be programmed to value 20 (Interlock). **2** = Interlocked start + timeout supervision. If feedback does not come within the interlock timeout time, start request is ignored and must be given again. **3** = Delayed start from I/O. Start request is given after delay time has expired.
P1.2.2	Intlk Timeout	0.00	300.00	s	5.00	1502	Timeout time for the interlock feedback waiting. Init = 5s.
P1.2.3	Start Delay Time	0.00	300.00	s	5.00	1503	Start delay time. Init = 5s.
P1.2.4	Slot A, DIN2 ExtFaulClose	0	20		1	319	**0** = Stop pulse when three-wire start/stop logic is selected. False=Stop, True=Ready to run. **1** = External fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accelerate/decelerate time selection **5** = Force ctrl. place to Hand **6** = Fire mode **7** = Force ctrl. place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accelerate/decelerate operation prohibit **12** = DC braking command **13** = Motor potentiometer, Up **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.5	Slot A, DIN3 Fault Reset	0	20		10	301	**0** = Not used **1** = External fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accelerate/decelerate time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accelerate/decelerate operation prohibit **12** = DC braking command **13** = Motor potentiometer, Down **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock
P1.2.6	Slot A, DIN4	0	22		21 ①	1504	Same as Slot A, DIN2, except **21** = Vibration cutout alarm, closing contact **22** = Vibration cutout alarm, opening contact

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN4 will be automatically set to selection 22, open contact.

August 2006

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.7	Slot A, DIN5	0	22		21 ①	330	**0** = Not used **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accelerate/decelerate time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accelerate/decelerate operation prohibit **12** = DC braking command **13** = Enable PID setpoint 2 **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock **21** = Vibration cutout fault, closing contact **22** = Vibration cutout fault, opening contact
P1.2.8	Slot A, DIN6	0	19		6	1505	Same as Slot A, DIN3, except **0** = Overload relay (automatic) and **19** = Interlock (no force bypass)
P1.2.9	AI-1 Signal Range	0	2		0	320	**0** = 0 – 100% **1** = 4 mA 20 – 100% **2** = Custom setting range
P1.2.10	AI-1 Custom Min	-160.00	160.00	%	0.00	321	
P1.2.11	AI-1 Custom Max	-160.00	160.00	%	100.00	322	
P1.2.12	AI-1 Signal Inv	0	1		0	323	**0** = Not inverted **1** = Inverted
P1.2.13	AI-1 Filter Time	0.00	10.00	s	0.10	324	**0** = No filtering
P1.2.14	AI-2 Signal Range	0	2		1	325	**0** = 0 - 20 mA **1** = 4 - 20 mA **2** = Custom setting range
P1.2.15	AI-2 Custom Min	-160.00	160.00	%	0.00	326	
P1.2.16	AI-2 Custom Max	-160.00	160.00	%	100.00	327	
P1.2.17	AI-2 Signal Inv	0	1		0	328	**0** = Not inverted **1** = Inverted
P1.2.18	AI-2 Filter Time	0.00	10.00	s	0.10	329	**0** = No filtering

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN5 will be automatically set to selection 22, open contact.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.19	MotPot Ramp Time	0.1	2000.0	/s	10.0	331	
P1.2.20	MotPotMemFreq Ref	0	2		1	367	Motor potentiometer (frequency reference) memory select: **0** = No action **1** = (Reset, Stop + Powerdown) **2** = Powerdown
P1.2.21	Ref. Scale Min	0.00	320.00	Hz	0.00	344	Selects the frequency that corresponds to the min. reference signal
P1.2.22	Ref. Scale Max	0.00	320.00	Hz	0.00	345	Selects the frequency that corresponds to the max. reference signal

Output Signals — M1 → G1.3

Table 8-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.1	Iout Content	0	15		1	307	Analog output function: **0** = Not used (scale 100%) **1** = O/P frequency (0 - f max.) **2** = Reference frequency (0 - f max) **3** = Motor speed (0 - 100% x Motor nom. speed) **4** = O/P current (0 - 100% x I nMot) **5** = Motor torque (0 - 100% x T nMot) **6** = Motor power (0 - 100% x P nMot) **7** = Motor voltage (0 - 100% x U nMot) **8** = DC bus voltage (0 - 100% x U nMot) **9** = PID controller reference value **10** = PID controller actual value 1 **11** = PID controller actual value 2 **12** = PID controller error value **13** = PID controller output **14** = PT100 temperature **15** = Fieldbus Command (FBProcessDataIN4)
P1.3.2	Iout Filter Time	0.00	10.00	s	1.00	308	
P1.3.3	Iout Invert	0	1		0	309	**0** = Not inverted **1** = Inverted
P1.3.4	Iout Minimum	0	1		1	310	**0** = 0 mA **1** = 4 mA
P1.3.5	Iout Scale	10	1000	%	100	311	

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.6	Slot A, DO-1	0	28		1	312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = Drive overheat warning **6** = External fault or warning **7** = Reference fault or warning **8** = Warning **9** = Reversed **10** = Jogging speed selected **11** = At speed **12** = Motor regulator activated **13** = Output frequency limit supervision 1 **14** = Output frequency limit supervision 2 **15** = Torque limit supervision **16** = Reference limit supervision **17** = External brake control **18** = Remote control, Active **19** = Frequency converter temperature limit supervision **20** = Unrequested rotation direction **21** = External brake control inverted **22** = Thermistor fault/warning **23** = Reserved **24** = Fire mode, Active **25** = Hand control, Active **26** = Auto control, Active **27** = Start delay relay (damper control) **28** = Running in bypass
P1.3.7	Slot B, RO-1	0	28		2	313	Same as parameter 1.3.6
P1.3.8	Slot B, RO-2	0	28		3	314	Same as parameter 1.3.6
P1.3.9 ①	Slot D, RO-1	0	28		0	1506	Same as parameter 1.3.6
P1.3.10 ①	Slot D, RO-2	0	28		0	1507	Same as parameter 1.3.6
P1.3.11 ①	Slot D, RO-3	0	28		0	1508	Same as parameter 1.3.6
P1.3.12	Freq Supv Lim 1	0	2		0	315	Frequency limit 1 supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.13	Freq Supv Val 1	0.00	Max_ Frequency	Hz	0.00	316	Frequency limit supervision value 1
P1.3.14	Freq Supv Lim 2	0	2		0	346	Frequency limit 2 supervision function: **0** = Not used **1** = Low limit **2** = High limit

① These parameters do not show up in keypad unless the appropriate option board is installed in Slot D.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.15	Freq Supv Val2	0.00	Max_ Frequency	Hz	0.00	347	Frequency limit supervision value 2
P1.3.16	Torque Supv Lim	0	2		0	348	Torque limit supervision function: 0 = Not used 1 = Low limit 2 = High limit
P1.3.17	Torque Supv Val	0.0	300.0	%	100.0	349	Torque limit supervision value
P1.3.18	Ref Superv Lim	0	2		0	350	Reference limit supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.19	Ref Superv Value	0.0	100.0	%	0.0	351	Reference limit supervision value
P1.3.20	Ext Brake OffDel	0.0	100.0	s	0.5	352	External brake off delay
P1.3.21	Ext Brake OnDel	0.0	100.0	s	1.5	353	External brake on delay
P1.3.22	Temp Limit Supv	0	2		0	354	Temperature limit supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.23	Temp Supv Value	-10	75	°C	40	355	Temperature limit supervision value

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Drive Control Parameters — M1 → G1.4

Table 8-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.4.1	Ramp 1 Shape	0.0	10.0	s	0.0	500	Accelerate/decelerate ramp 1 shape: **0** = Linear **>0** = S curve acc./dec. ratio
P1.4.2	Ramp 2 Shape	0.0	10.0	s	0.0	501	Accelerate/decelerate ramp 2 shape: **0** = Linear **>0** = S curve acc./dec. ratio
P1.4.3 ①	Accel Time 2	0.1	3000.0	s	2.0	502	Acceleration time 2: Time from min. frequency to max. frequency
P1.4.4 ①	Decel Time 2	0.1	3000.0	s	2.0	503	Deceleration Time 2: Time from max. frequency to min. frequency
P1.4.5	Brake Chopper	0	4		0	504	Brake chopper mode selection: **0** = Brake NO, Test NO **1** = Brake YES (Run), Test YES (Ready + Run) **2** = Brake Chopper EXTERNAL, Test NO **3** = Brake YES (Ready + Run), Test YES (Ready + Run) **4** = Brake YES (Run), Test NO
P1.4.6	Start Function	0	1		0	505	**0** = Ramp **1** = Flying start
P1.4.7	Stop Function	0	1		0	506	**0** = Coasting **1** = Ramp
P1.4.8	DC-Brake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	507	DC brake current
P1.4.9	Stop DC-BrakeTm	0.00	600.00	s	0.00	508	DC brake time(s) in ramp stop
P1.4.10	Stop DC-BrakeFr	0.10	10.00	Hz	1.50	515	DC brake is allowed under this frequency limit.
P1.4.11	Start DC-BrakeTm	0.00	600.00	s	0.00	516	(W) DC brake time (ms) in ramp start. Init = 0
P1.4.12	Flux Brake	0	1		0	520	**1** = Flux braking enabled
P1.4.13	FluxBrake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	519	Flux brake current Default = MotorNomCurrent

① Accel Time 2 and Decel Time 2 are used when PID control is active.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Skip Frequencies — M1 → G1.5

Table 8-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.5.1	Range 1 High Lim	0.00	Max_ Frequency	Hz	0.00	510	Skip frequency range 1 high limit: **0** = No prohibit frequency range
P1.5.2	Range 1 Low Lim	0.00	Range_1_ High_Lim	Hz	0.00	509	Skip frequency range 1 low limit
P1.5.3	Range 2 High Lim	0.00	Max_ Frequency	Hz	0.00	512	Skip frequency range 2 high limit: **0** = No prohibit frequency range
P1.5.4	Range 2 Low Lim	0.00	Range_2_ High_Lim	Hz	0.00	511	Skip frequency range 2 low limit
P1.5.5	Range 3 High Lim	0.00	Max_ Frequency	Hz	0.00	514	Skip frequency range 3 high limit: **0** = No prohibit frequency range
P1.5.6	Range 3 Low Lim	0.00	Range_3_ High_Lim	Hz	0.00	513	Skip frequency range 3 low limit
P1.5.7	PH Acc/Dec Ramp	0.1	10.0	x	1.0	518	Acc./dec. ramp scaling ratio between prohibit frequency limits

Motor Control Parameters — M1 → G1.6

Table 8-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.1	Motor Ctrl Mode	0	Control ModeMax		0	600	Motor control mode: **0** = Frequency control **1** = Speed control
P1.6.2	V/Hz Optim.	0	1		0	109	U/F optimization selection: **0** = None **1** = Automatic torque boost
P1.6.3	V/Hz Ratio	0	3		0	108	U/F ratio selection: **0** = linear **1** = squared **2** = programmable **3** = Linear with flux optim
P1.6.4	Field WeakngPnt	8.00	320.00	Hz	60.00	602	Field weakening point
P1.6.5	Voltage at FWP	10.00	200.00	%	100.00	603	Motor voltage (%*NotorNomVoltage) at field weakening point
P1.6.6	V/Hz Mid Freq	0.00	Field Weakening Point	Hz	60.00	604	Programmable U/F curve middle point frequency
P1.6.7	V/Hz Mid Voltg	0.00	100.00	%	100.00	605	Motor voltage (%*MotorNomVoltage) at programmable U/F curve middle point

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-7: Motor Control Parameters — M1 → G1.6, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.8	Zero Freq Voltg	0.00	40.00	%	1.50	606	Motor voltage (%*MotorNomVoltage) at programmable U/F curve zero point
P1.6.9	Switching Freq	1.0	Switching FreqMax	kHz	10.0	601	Switching frequency in kHz. Depends on drive hp rating.
P1.6.10	Overvolt Contr	0	2		1	607	**0** = Off **1** = On with no ramping **2** = On with ramping
P1.6.11	Undervolt Contr	0	1		1	608	**0** = Off **1** = On
P1.6.12	LoadDrooping	0.00	100.00	%	0.00	620	[W] Load Drooping (0 …10000) = 0 … 100% of nominal speed at nominal torque.
P1.6.13	Identification	0	2		0	631	**0** = ID run **1** = Overload V/f ratio **2** = Overload V/f plus boast

Protections — M1 → G1.7

Table 8-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.1	4mA Fault Resp	0	5		4	700	Response to reference fault: **0** = No action **1** = Warning **2** = Warning, old frequency **3** = Warning, preset frequency **4** = Fault, stop according to P1.4.7 **5** = Fault, stop always by coasting
P1.7.2	4mA Fault Freq.	0.00	Max_ Frequency	Hz	0.00	728	Preset (reference) frequency if Ref Fault and P1.7.1 = 3
P1.7.3	External Fault	0	3		2	701	Response to external fault: **0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.4	Input Phase Supv	0	3		0	730	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.5	UVolt Fault Resp	0	1		0	727	**0** = Fault stored to History **1** = Fault not stored to History

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.6	OutputPh. Superv	0	3		2	702	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.7	Ground fault	0	3		2	703	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.8	Motor Therm Prot	0	3		2	704	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.9	MotAmbTemp Factor	-100.0	100.0	%	0.0	705	Ambient temperature of the motor (-100.0… 100.0%) 0.0= nominal, 100.0= max.
P1.7.10	MTP f0 Current	0.0	150.0	%	40.0	706	Motor cooling ability at zero speed
P1.7.11	MTP Motor T	1	200	min	45	707	Motor thermal time constant in minutes
P1.7.12	Motor Duty Cycle	0	100	%	100	708	Motor duty cycle in %
P1.7.13	Stall Protection	0	3		1	709	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.14	Stall Current	Motor CurrentMin	Motor CurrentMax	A	Motor Nom Current * 1.3	710	Current limit of motor stall protection (0.1A - [Motor nom. current * 2])
P1.7.15	Stall Time Lim	1.00	120.00	s	15.00	711	Max. time for stall
P1.7.16	Stall Freq Lim	1.00	Max_ Frequency	Hz	25.00	712	Max. frequency for stall protection
P1.7.17	Underload Protec	0	3		0	713	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.18	UP fnom Torque	10.0	150.0	%	50.0	714	Underload load curve at nominal frequency
P1.7.19	UP f0 Torque	5.0	150.0	%	10.0	715	Underload load curve at zero frequency

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.20	UP Time Limit	2.00	600.00	s	20.00	716	Time limit for underload supervision
P1.7.21	ThermistorF. Resp	0	3		2	732	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.22	FBComm.Fault Resp	0	3		2	733	Response to fieldbus fault **0** = No action **1** = Warning **2** = Fault
P1.7.23	SlotComFault Resp	0	3		2	734	Response to option card fault **0** = No action **1** = Warning **2** = Fault
P1.7.24	PT100 Numbers	0	3		0	739	
P1.7.25	PT100 FaultRespo	0	3		0	740	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.26	PT100 Warn.Limit	-30.0	200.0	°C	120.0	741	
P1.7.27	PT100 Fault Lim.	-30.0	200.0	°C	130.0	742	

Auto Restart Parameters — M1 → G1.8

Table 8-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.8.1	Wait Time	0.10	10.00	s	0.50	717	
P1.8.2	Trial Time	0.00	60.00	s	30.00	718	
P1.8.3	Start Function	0	2		1	719	**0** = Ramp **1** = Flying start **2** = System defined
P1.8.4	Undervolt. Tries	0	10	x	0	720	
P1.8.5	Overvolt. Tries	0	10	x	0	721	
P1.8.6	Overcurr. Tries	0	3	x	0	722	
P1.8.7	4mA Fault Tries	0	10	x	0	723	
P1.8.8	MotTempF Tries	0	10	x	0	726	
P1.8.9	Ext.Fault Tries	0	10	x	0	725	
P1.8.10	Underload tries	0	10	x	0	738	

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Fire Mode Parameters — M1 → G1.9

Table 8-10: Fire Mode Parameters — M1 → G1.9

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.9.1 ①	FireMode Function	0	1		0	1509	Fire mode input function: **0** = Closing contactor **1** = Opening contactor
P1.9.2	FMRef Sel Invert	0	1		0	1510	Fire mode reference selection inversion. Default = Not Inverted.
P1.9.3	FireMode MinFreq	Min_ Frequency	FreqMax	Hz	15.00	1511	Fire mode min. frequency. Default = 15.00Hz.
P1.9.4	FireMode Ref. 1	0.0	100.0	%	75.0	1512	Fire mode frequency reference 1. Default = 75.0% of P1.1.2.
P1.9.5	FireMode Ref. 2	0.0	100.0	%	100.0	1513	Fire mode frequency reference 2. Default = 100.0% of P1.1.2.

① See Important ⚠ Warning on Fire Mode operation on **Page 11-43**. Electronic overload must be set to "Auto" versus "Manual" for "emergency operation" and continued running of motor even if electronic overload trips.

Preset Speed Parameters — M1 → G1.10

Table 8-11: Preset Speed Parameters — M1 → G1.10

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.10.1	Preset Speed 1	0.0	100.0	%	15.0	1514	Preset speed 1 reference. Percentages of max. frequency. Default = 15.0%.
P1.10.2	Preset Speed 2	0.0	100.0	%	30.0	1515	Preset speed 2 reference. Percentages of max. frequency. Default = 30.0%.
P1.10.3	Preset Speed 3	0.0	100.0	%	45.0	1516	Preset speed 3 reference. Percentages of max. frequency. Default = 45.0%.
P1.10.4	Preset Speed 4	0.0	100.0	%	60.0	1517	Preset speed 4 reference. Percentages of max. frequency. Default = 60.0%.
P1.10.5	Preset Speed 5	0.0	100.0	%	75.0	1518	Preset speed 5 reference. Percentages of max. frequency. Default = 75.0%.
P1.10.6	Preset Speed 6	0.0	100.0	%	100.0	1519	Preset speed 6 reference. Percentages of max. frequency. Default = 100.0%.

Table 8-12: Binary Inputs for Preset Speeds

Preset Speed #	PM Setback DIN On	Preset Speed 1	Preset Speed 2
PM Setback Ref %	1	0	0
1	0	1	0
2	1	1	0
3	0	0	1
4	1	0	1
5	0	1	1
6	1	1	1

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

PID-Control Parameters — M1 → G1.11

Table 8-13: PID-Control Parameters — M1 → G1.11

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.11.1 ①	PID Control	0	1		0	1523	**0** = Disabled **1** = Enabled
P1.11.2	PIDSetpointSrce	0	4		2	332	**0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Setpoint from keypad **3** = Fieldbus reference (ProcessDataIN 1) **4** = Motor potentiometer
P1.11.3	Engineering Unit	0	1		0	1926	Selection for Temperature Fahrenheit, Celcius (0) Engineering units or Percentage (1)
P1.11.4	Setpoint Min.	43°F/6.0°C/ 0.0%	Setpoint Max.	°F/ °C/%	43/6.0/ 0.0%	1524	PID setpoint min. limit
P1.11.5	Setpoint Max.	Setpoint Min.	120°F/ 49.0°C/ 100.0%	°F/ °C/%	120/ 49.0/ 100.0%	1525	PID setpoint max. limit
P1.11.6	Act Value Select	0	7		0	333	**0** = Actual value1 **1** = Actual 1 + Actual 2 **2** = Actual 1 - Actual 2 **3** = Actual 1 * Actual 2 **4** = Min. (Actual 1, Actual 2) **5** = Max. (Actual 1, Actual 2) **6** = Mean (Actual 1, Actual 2) **7** = Sqrt (Actual 1) + Sqrt(Actual 2)
P1.11.7	Actual 1 Input	0	8		2	334	**0** = Not used **1** = AI-1 signal (control board) **2** = AI-2 signal (control board) **3** = Fieldbus (ProcessDataIN 2) **4** = Motor torque **5** = Motor speed **6** = Motor current **7** = Motor power **8** = Encoder frequency
P1.11.8	Actual 2 Input	0	8		0	335	**0** = Not used **1** = AI-1 signal (control board) **2** = AI-2 signal (control board) **3** = Fieldbus (ProcessDataIN 3) **4** = Motor torque **5** = Motor speed **6** = Motor current **7** = Motor power **8** = Encoder frequency
P1.11.9	Sensor Min Scale	-100°F/ -73.0°C/0.0%	Sensor_Max _Scale	°F/ °C/%	0°F/ -17.8°C/ 0.0%	1521	Temperature sensor min. scale value
P1.11.10	Sensor Max Scale	Sensor_Min _Scale	300°F/ 149.0°C/ 100.0%	°F/ °C/%	200°F/ 93.3°C/ 100.0%	1522	Temperature sensor max. scale value

① PID Control can be enabled independently for “Hand” or “Auto” from parameters P1.1.16 and P1.1.18 by using selection 5 PID Control.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Table 8-13: PID-Control Parameters — M1 → G1.11, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.11.11	Error Inversion	0	1		1	340	**0** = Inverted (reverse acting **1** = Not Inverted (direct acting)
P1.11.12	PID-Contr Gain	0.00	10.00		0.20	118	**0** = No P-part in use
V1.11.13 ①	PID-Contr Gain	0.00	10.00		0.20	1622	**0** = No P-part in use
P1.11.14	PID-Contr I Time	0.00	320.00	s	1.00	119	**320.00 s** = No I-part in use
V1.11.15 ①	PID-Contr I Time	0.00	320.00	s	1.00	1644	**320.00 s** = No I-part in use
P1.11.16	PID-Contr D Time	0.00	100.00	s	0.00	132	PID controller deriv. time **0** = No D-part in use
V1.11.17 ①	PID-Contr D Time	0.00	100.00	s	0.00	1688	PID controller deriv. time **0** = No D-part in use
P1.11.18	PID Min Limit	-1000.0	PIC_Max_ Limit	%	0.0	359	Min. value of the PID controller output
P1.11.19	PID Max Limit	PIC_Min_ Limit	1000.0	%	100.0	360	Max. value of the PID controller output
P1.11.20	Setpnt Rise Time	0.1	100.0	s	5.0	341	Time for reference value change from 0 % to 100 %
P1.11.21	Setpnt Fall Time	0.1	100.0	s	5.0	342	Time for reference value change from 100 % to 0 %
P1.11.22	Sleep Speed Lim.	0.0	100.0	%	15.0	1016	Speed below which the speed of the speed controlled motor has to go before starting the sleep delay counting. 0.0 = Not in use.
P1.11.23	Sleep Delay	0	3600	s	60	1017	Time that the speed has to be below sleep speed before stopping the drive
P1.11.24	Wake Up Limit	Sensor_Min _Scale	Sensor_Max _Scale	°F/ °C/%	70°F/ 21.7°C/ 25.0%	1018	Level of the actual value for restarting the drive
P1.11.25	Wake Up Action	0	1		1	1019	**0** = Wake up falling below the Wake Up limit level P1.11.24 **1** = Wake up exceeding the Wake Up limit level P1.11.24
P1.11.26	MotPotMem PISp.	0	2		0	370	Motor potentiometer (PI setpoint) memory select: **0** = No Reset **1** = (Reset, Stop + Powerdown) **2** = Powerdown

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Fieldbus Parameters — M1 → G1.12

Table 8-14: Fieldbus Parameters — M1 → G1.12

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P.1.12.1	FB Data Out1 Sel	0	10000		20	852	PID setpoint
P.1.12.2	FB Data Out2 Sel	0	10000		21	853	PID actual
P.1.12.3	FB Data Out3 Sel	0	10000		23	854	Fan speed %
P.1.12.4	FB Data Out4 Sel	0	10000		22	855	PID error
P.1.12.5	FB Data Out5 Sel	0	10000		13	856	AI 1
P.1.12.6	FB Data Out6 Sel	0	10000		14	857	AI 2
P.1.12.7	FB Data Out7 Sel	0	10000		17	858	DO1, RO1, RO2 status
P.1.12.8	FB Data Out8 Sel	0	10000		26	859	Analog I_{out}
P1.12.9 ②	FLN Address	0	99	1	99	1900	
V1.12.10 ①	FLN Address	0	99	1	99	1589	

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

② Parameter present only if using Siemens Apogee Communications Software.

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 8-15: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	ID Number ①	Description
R2.1	Keypad Reference	0.0	100.0	%	0.0	NA	Keypad reference
R2.2	Temperature Setpoint	PID Setpoint Min.	PID Setpoint Max.	°F/ °C/%	80°F/ 26.7°C/ 0.0%	NA	PID keypad setpoint
P2.3	Keypad Direction	0	1		0	123	Reverse request active from the panel: **0** = Forward **1** = Reverse
P2.4	StopButton Active	0	1		Yes	114	Stop button (keypad) always active (Yes/No)

① Keypad Control Parameter ID Numbers are listed separately on **Page 11-45**.

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in **Chapter 6**.

BAC Temp F/C Application (SVCHS302/SVCHS304), continued

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited. See **Chapter 6** for more information.

Table 8-16: Monitoring Menu

Code	Parameter	Min.	Max.	Unit	ID #	Description
V7.1	Fan Speed	-320.00	320.00	Hz	1	Output frequency to motor
V7.2	Temp. Setpoint	43°F/6.0°C/0.0%	120°F/49.0°C/ 100.0%	°F/°C/%	20	PID temperature setpoint
V7.3	Leaving Wtr Temp	-100°F/-73.0°C/ 0.0%	300°F/149.0°C/ 100.0%	°F/°C/%	21	Exiting water temperature
V7.4	Fan Speed	-100.0	100.0	%	1845	PID output in %
V7.5	PID Error	-100.0°F/ -122.0°C/ -100.0%	500.0°F/ 143.0°C/100.0%	°F/°C/%	22	Error between PID actual and PID setpoint
V7.6	Fan Reference	-320.0	320.0	%	1520	Motor reference in %
V7.7	Frequency Reference	-320.0	320.0	Hz	25	Frequency Ref
V7.8	Motor Speed	-10000	10000	rpm	2	Calculated motor speed in rpm
V7.9	Motor Current	0.0	Motor Current Max	A	3	Motor current
V7.10	Motor Torque	-300.0	300.0	%	4	Calculated torque as a % of nominal torque
V7.11	Motor Power	-300.0	300.0	%	5	Calculated motor shaft power
V7.12	Motor Voltage	0.0	1000.0	VAC	6	Calculated motor voltage
V7.13	DC Bus Voltage	0	1000	VDC	7	DC bus voltage
V7.14	Unit Temperature	-50	300	°C	8	Heatsink temperature
V7.15	Motor Temperature	0.0	1000.0	%	9	Calculated motor temperature
V7.16	Analog Input 1	-10.00	20.00	V	13	Analog Input 1
V7.17	Analog Input 2	-10.00	20.00	mA	14	Analog Input 2
V7.18	DIN1 – DIN3 Status	0	7	OFF/ON	15	Status of DIN1 thru DIN3
V7.19	DIN4 – DIN6 Status	0	7	OFF/ON	16	Status of DIN4 thru DIN6
V7.20	DIN Status	0	32000		1904	
V7.21	DO1, RO1, RO2 Status	0	7	OFF/ON	17	Digital and relay output status
V7.22	RO3, RO4, RO5	0	7		1898	
V7.23	Relay Out Status	0	36500		1773	
V7.24	Analog Iout	0.00	20.00	mA	26	Analog output AO 1
V7.25	PT100 temperature	-30.0	200.0	°C	42	Highest temperature of used inputs; needs option board (OPTB8)
G7.26	Multimonitor	—	—	—	—	—

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See **Chapter 6** for more information.

Chapter 9 — BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303)

Introduction

The BAC Pressure PSIG/Bar Application of the BAC VFD provides for two different control places – the PID controller and direct frequency reference. The PID control is selected by digital input DIN2 – DIN6 selection 16 or by enabling parameter P1.11.1 PID Control. PID can also be selected dependent on Hand or Auto control by selecting either P1.1.16 StPt Source Hand to "PID-Control" or P1.1.18 StPt Source Auto to "PID-Control." This allows PID operation in either Hand or Auto and direct frequency reference in the other. P1.11.1 PID control should be disabled for this operation.

The PID controller setpoint can be selected from the analog inputs, fieldbus, motor potentiometer or by applying the control keypad reference. The PID controller actual value can be selected from the analog inputs, fieldbus, the actual values of the motor or through the mathematical functions of these.

The direct frequency reference can be used for the control without the PID controller and is selected from the analog inputs, fieldbus, motor potentiometer or keypad.

The Pressure Control Application is typically used to control refrigerant condensing pressure. In these applications, the Pressure Control Application provides a smooth control and an integrated measurement and control package where no additional components are needed.

- Digital inputs DIN2 through DIN6 and all outputs are freely programmable.

Additional functions:

- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: Programmable action; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Sum point frequency addition to PID output
- The PID controller can additionally be used from control places I/O B, the keypad and the fieldbus
- Easy Change Over function
- Sleep function

Details of the parameters shown in this section are available in **Chapter 11** of this Manual, listed by parameter ID number.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Control Input/Output

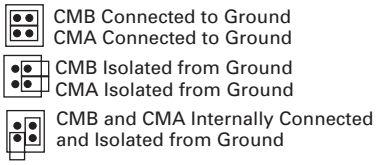
Table 9-1: BAC Pressure PSIG/Bar Application Default I/O Configuration

	Terminal	Signal	Description
OPTA9			
	1 +10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
0 to 10V DC (Factory Default)	2 AI-1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
	3 AI-1-	I/O Ground	Ground for reference and controls
4 to 20 mA (Factory Default)	4 AI-2+	Analog input, current range 0 – 20 mA	Current input frequency reference
	5 AI-2-		
	6 +24V	Control voltage output	Voltage for switches, etc. max 0.1A
	7 GND	I/O ground	Ground for reference and controls
External Wiring	8 DIN1	Start/Stop Control	Contact closed = Start
	9 DIN2	External fault input (programmable)	Contact closed = Fault Contact open = No fault
	10 DIN3	Fault reset (programmable)	Contact closed = Fault reset
	11 CMA	Common for DIN1 – DIN3	Connect to GND or +24V
	12 +24V	Control voltage output	Voltage for switches (see terminal 6)
	13 GND	I/O ground	Ground for reference and controls
External Wiring	14 DIN4	Vibration Cutout Alarm (programmable)	Contact open = Alarm ①
	15 DIN5	Vibration Cutout Fault (programmable)	Contact open = Fault ②
	16 DIN6	Overload Relay Fault	Contact closed = Fault
	17 CMB	Common for DIN4 – DIN6	Connect to GND or +24V
4 to 20 mA (Factory Default)	18 AO-1+	Motor Speed Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
	19 AO-1-		
	20 DO-1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
Defaults:	**OPTA2**		
21-22 Opens on RUN	21 RO-1	Relay output 1 RUN	Programmable
22-23 Closes on RUN	22 RO-1		
	23 RO-1		
24-25 Opens on FAULT	24 RO-2	Relay output 2 FAULT	Programmable
25-26 Closes on FAULT	25 RO-2		
	26 RO-2		

① Programmed from Start-Up Wizard or from Parameter P1.1.18 or selection 22, P1.2.6 VibAlmOpen.
② Programmed from Start-Up Wizard or from Parameter P1.1.17 or selection 22, P1.2.7 Vib Fault Open.

Note: For information on jumper selections, see **Page 4-5**.

X3 Jumper Setting — CMA and CMB Grounding


CMB Connected to Ground
CMA Connected to Ground
CMB Isolated from Ground
CMA Isolated from Ground
CMB and CMA Internally Connected
and Isolated from Ground

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 11**.

Column explanations:

Code = Location indication on the keypad; Shows the operator the present parameter number
Parameter = Name of parameter
Min. = Minimum value of parameter
Max. = Maximum value of parameter
Unit = Unit of parameter value; Given if available
Default = Value preset by factory
ID = ID number of the parameter for reference to **Chapter 11**

Basic Parameters — M1 → G1.1

Table 9-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.1	Min Frequency	0.00	Max_ Frequency	Hz	6.00	101	Min. output frequency
P1.1.2	Max Frequency	FreqMin	320.00	Hz	60.00	102	Max. output frequency
P1.1.3	Accel Time 1	0.1	3000.0	s	60.0	103	Time from min. frequency to max. frequency
V1.1.4 ①	Accel Time 1	0.1	3000.0	s	60.0	1690	Time from min. frequency to max. frequency
P1.1.5	Decel Time 1	0.1	3000.0	s	60.0	104	Time from max. frequency to min. frequency
V1.1.6 ①	Decel Time 1	0.1	3000.0	s	60.0	1691	Time from max. frequency to min. frequency
P1.1.7	Motor Nom Voltg	180	690	V	460	110	Motor nominal voltage in volts
P1.1.8	Motor Nom Freq	8.00	320.00	Hz	60.00	111	Motor nominal frequency
P1.1.9	Motor Nom Speed	24	20000	rpm	1760	112	Motor nominal speed in rpm
P1.1.10	Motor Nom Currnt	Motor CurrentMin	Motor CurrentMax	A	Varies	113	Motor nominal current
P1.1.11	Motor Service Factor	0.00	2.00	x	1.15	1685	Motor service factor. This value is multiplied by the motor nominal current to set the current limit.
P1.1.12	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	107	Output current limit
V1.1.13 ①	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	1624	Output current limit
P1.1.14	Power Factor	0.30	1.00		0.85	120	Motor Cos Phii or Power Factor

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.15	Start Srce Hand	1	3		1	171	Parameter for local start/stop control location. Default = Keypad **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire
P1.1.16	Setpoint Source Hand	0	5		2	173	Local frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer **5** = PID controller output
P1.1.17	Start Srce Auto	1	4		2	172	Parameter for remote start/stop control location: Default = DIN1 start **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire **4** = Fieldbus
P1.1.18	Setpoint Source Auto	0	5		5	174	Remote frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer **5** = PID controller output
P1.1.19	PM Setback Ref.	0.0	100.0	%	30.0	1500	PM setback speed reference. Percentages of maximum frequency. Default = 30.0%.
P1.1.20	VCOS Shutdown	No	Yes	–	No	1837	VCOS Vibration cutout switch for drive fault. ②
P1.1.21	VCOS Alarm	No	Yes	–	No	1838	VCOS Vibration cutout alarm switch. ②

① This selection can be used along with a constant "start" signal if automatic restart is desired after a power cycle.

② These two parameters exist in the Start-Up Wizard. When selecting either "no" or "yes", you force P1.2.6 (Slot A, DIN4) or P1.2.7 (Slot A, DIN5) for either selection 21 "no" Vibration Cutout (closed contact) or selection 22 "yes" Vibration Cutout (open contact). If P1.2.6 or P1.2.7 digital inputs are programmed for anything other than the Vibration Cutout, then these two parameters should not be changed, otherwise they will force the selections for DIN4 or DIN5 to "21" or "22".

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Input Signals — M1 → G1.2

Table 9-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.1	Start Function	0	3		0	1501	Start Function: **0** = Normal start from I/O without interlockings. **1** = Interlocked start from I/O. One of the digital/relay outputs must be programmed to value 27 (Interlock) and one of the digital inputs must be programmed to value 20 (Interlock) **2** = Interlocked start + timeout supervision. If feedback does not come within the interlock timeout time, start request is ignored and must be given again. **3** = Delayed start from I/O. Start request is given after delay time has expired.
P1.2.2	Intlk Timeout	0.00	300.00	s	5.00	1502	Timeout time for the interlock feedback waiting. Init = 5s.
P1.2.3	Start Delay Time	0.00	300.00	s	5.00	1503	Start delay time. Init = 5s.
P1.2.4	Slot A, DIN2 ExtFaulClose	0	20		1	319	**0** = Stop pulse, when three-wire start/stop logic is selected. (False=Stop, True=Ready to run) **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accel./decel. time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Motor potentiometer, Up **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.5	Slot A, DIN3 Fault Reset	0	20		10	301	**0** = Not used **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accel./decel. time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Motor potentiometer, Down **14** = Fire mode reference Activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock
P1.2.6	Slot A, DIN4	0	22		21 ①	1504	Same as Slot A, DIN3, except **21** = Vibration cutout alarm, closing contact **22** = Vibration cutout alarm, opening contact

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN4 will be automatically set to selection 22, open contact.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.7	Slot A, DIN5	0	22		21 ①	330	**0** = Not used **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accel./decel. time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Enable PID setpoint 2 **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock **21** = Vibration cutout fault, closing contact **22** = Vibration cutout fault, opening contact
P1.2.8	Slot A, DIN6	0	19		6	1505	Same as Slot A, DIN3, except **0** = Overload relay (automatic) and **19** = Interlock (no force bypass)
P1.2.9	AI-1 Signal Range	0	2		0	320	**0** = 0 – 100% **1** = 4 mA 20 – 100% **2** = Custom setting range
P1.2.10	AI-1 Custom Min	-160.00	160.00	%	0.00	321	
P1.2.11	AI-1 Custom Max	-160.00	160.00	%	100.00	322	
P1.2.12	AI-1 Signal Inv	0	1		0	323	**0** = Not inverted **1** = Inverted
P1.2.13	AI-1 Filter Time	0.00	10.00	s	0.10	324	**0** = No filtering
P1.2.14	AI-2 Signal Range	0	2		1	325	**0** = 0 - 20 mA **1** = 4 - 20 mA **2** = Custom setting range
P1.2.15	AI-2 Custom Min	-160.00	160.00	%	0.00	326	
P1.2.16	AI-2 Custom Max	-160.00	160.00	%	100.00	327	
P1.2.17	AI-2 Signal Inv	0	1		0	328	**0** = Not inverted **1** = Inverted
P1.2.18	AI-2 Filter Time	0.00	10.00	s	0.10	329	**0** = No filtering

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN5 will be automatically set to selection 22, open contact.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.19	MotPot Ramp Time	0.1	2000.0	/s	10.0	331	
P1.2.20	MotPotMemFreq Ref	0	2		1	367	Motor potentiometer (frequency reference) memory select: **0** = No Action **1** = (Reset, Stop + Powerdown) **2** = Powerdown
P1.2.21	Ref. Scale Min	0.00	320.00	Hz	0.00	344	Selects the frequency that corresponds to the min. reference signal
P1.2.22	Ref. Scale Max	0.00	320.00	Hz	0.00	345	Selects the frequency that corresponds to the max. reference signal

Output Signals — M1 → G1.3

Table 9-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.1	Iout Content	0	15		1	307	Analog output function: **0** = Not used (scale 100%) **1** = O/P frequency (0 - f max) **2** = Reference frequency (0 - f max) **3** = Motor speed (0 - 100% x Motor nom. speed) **4** = O/P current (0 - 100% x I nMot) **5** = Motor torque (0 - 100% x T nMot) **6** = Motor power (0 - 100% x P nMot) **7** = Motor voltage (0 - 100% x U nMot) **8** = DC bus voltage (0 - 100% x U nMot) **9** = PID controller reference value **10** = PID controller actual value 1 **11** = PID controller actual value 2 **12** = PID controller error value **13** = PID controller output **14** = PT100 Temperature **15** = Fieldbus Command (FBProcessDataIN4)
P1.3.2	Iout Filter Time	0.00	10.00	s	1.00	308	
P1.3.3	Iout Invert	0	1		0	309	**0** = Not inverted **1** = Inverted
P1.3.4	Iout Minimum	0	1		1	310	**0** = 0 mA **1** = 4 mA
P1.3.5	Iout Scale	10	1000	%	100	311	

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.6	Slot A, DO-1	0	28		1	312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = Drive overheat warning **6** = External fault or warning **7** = Reference fault or warning **8** = Warning **9** = Reversed **10** = Jogging speed selected **11** = At speed **12** = Motor regulator activated **13** = Output frequency limit supervision 1 **14** = Output frequency limit supervision 2 **15** = Torque limit supervision **16** = Reference limit supervision **17** = External brake control **18** = Remote control, Active **19** = Frequency converter temperature limit supervision **20** = Unrequested rotation direction **21** = External brake control inverted **22** = Thermistor fault/warning **23** = Reserved **24** = Fire mode, Active **25** = Hand control, Active **26** = Auto control, Active **27** = Start delay relay (damper control) **28** = Running in bypass
P1.3.7	Slot B, RO-1	0	28		2	313	Same as parameter 1.3.6
P1.3.8	Slot B, RO-2	0	28		3	314	Same as parameter 1.3.6
P1.3.9 ①	Slot D, RO-1	0	28		0	1506	Same as parameter 1.3.6
P1.3.10 ①	Slot D, RO-2	0	28		0	1507	Same as parameter 1.3.6
P1.3.11 ①	Slot D, RO-3	0	28		0	1508	Same as parameter 1.3.6
P1.3.12	Freq Supv Lim 1	0	2		0	315	Frequency limit 1 supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.13	Freq Supv Val 1	0.00	Max_ Frequency	Hz	0.00	316	Frequency limit supervision value 1
P1.3.14	Freq Supv Lim 2	0	2		0	346	Frequency limit 2 supervision function: **0** = Not used **1** = Low limit **2** = High limit

① These parameters do not show up in keypad unless the appropriate option board is installed in Slot D.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.15	Freq Supv Val2	0.00	Max_ Frequency	Hz	0.00	347	Frequency Limit Supervision Value 2
P1.3.16	Torque Supv Lim	0	2		0	348	Torque Limit Supervision Function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.17	Torque Supv Val	0.0	300.0	%	100.0	349	Torque Limit Supervision Value
P1.3.18	Ref Superv Lim	0	2		0	350	Reference Limit Supervision Function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.19	Ref Superv Value	0.0	100.0	%	0.0	351	Reference Limit Supervision Value
P1.3.20	Ext Brake OffDel	0.0	100.0	s	0.5	352	Ext_Brake_OffDelay
P1.3.21	Ext Brake OnDel	0.0	100.0	s	1.5	353	Ext_Brake_OnDelay
P1.3.22	Temp Limit Supv	0	2		0	354	Temperature Limit Supervision Function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.23	Temp Supv Value	-10	75	°C	40	355	Temperature Limit Supervision value

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Drive Control Parameters — M1 → G1.4

Table 9-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.4.1	Ramp 1 Shape	0.0	10.0	s	0.0	500	Accel./decel. ramp 1 shape: **0** = Linear **>0** = S-curve accel./decel. ratio
P1.4.2	Ramp 2 Shape	0.0	10.0	s	0.0	501	Accel./decel. ramp 2 shape: **0** = Linear **>0** = S-curve accel./decel. ratio
P1.4.3 ①	Accel Time 2	0.1	3000.0	s	2.0	502	Acceleration time 2: Time from min. frequency to max. frequency
P1.4.4 ①	Decel Time 2	0.1	3000.0	s	2.0	503	Deceleration time 2: Time from max. frequency to min. frequency
P1.4.5	Brake Chopper	0	4		0	504	Brake chopper mode selection: **0** = Brake NO, Test NO **1** = Brake YES (Run), Test YES (Ready + Run) **2** = Brake chopper EXTERNAL, Test NO **3** = Brake YES (Ready + Run), Test YES (Ready + Run) **4** = Brake YES (Run), Test NO
P1.4.6	Start Function	0	1		0	505	**0** = Ramp **1** = Flying start
P1.4.7	Stop Function	0	1		0	506	**0** = Coasting **1** = Ramp
P1.4.8	DC-Brake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	507	DC brake current
P1.4.9	Stop DC-BrakeTm	0.00	600.00	s	0.00	508	DC brake time (s) in ramp stop
P1.4.10	Stop DC-BrakeFr	0.10	10.00	Hz	1.50	515	DC brake is allowed under this frequency limit
P1.4.11	Start DC-BrakeTm	0.00	600.00	s	0.00	516	[W] DC brake time [ms] in ramp start. Init = 0.
P1.4.12	Flux Brake	0	1		0	520	**1** = flux braking is enabled.
P1.4.13	FluxBrake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	519	Flux brake current Default = MotorNomCurrent

① Accel Time 2 and Decel Time 2 are used when PID control is active.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Skip Frequencies — M1 → G1.5

Table 9-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.5.1	Range 1 High Lim	0.00	Max_ Frequency	Hz	0.00	510	Skip frequency range 1 high limit: **0** = No prohibit frequency range
P1.5.2	Range 1 Low Lim	0.00	Range_1_ High_Lim	Hz	0.00	509	Skip frequency range 1 low limit
P1.5.3	Range 2 High Lim	0.00	Max_ Frequency	Hz	0.00	512	Skip frequency range 2 high limit: **0** = No prohibit frequency range
P1.5.4	Range 2 Low Lim	0.00	Range_2_ High_Lim	Hz	0.00	511	Skip frequency range 2 low limit
P1.5.5	Range 3 High Lim	0.00	Max_ Frequency	Hz	0.00	514	Skip frequency range 3 high limit: **0** = No prohibit frequency range
P1.5.6	Range 3 Low Lim	0.00	Range_3_ High_Lim	Hz	0.00	513	Skip frequency range 3 low limit
P1.5.7	PH Acc/Dec Ramp	0.1	10.0	x	1.0	518	Acc/dec ramp scaling ratio between prohibit frequency limits

Motor Control Parameters — M1 → G1.6

Table 9-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.1	Motor Ctrl Mode	0	Control ModeMax		0	600	Motor control mode: **0** = Frequency control **1** = Speed control
P1.6.2	V/Hz Optim.	0	1		0	109	U/F optimization selection: **0** = None **1** = Automatic torque boost
P1.6.3	V/Hz Ratio	0	3		0	108	U/F ratio selection: **0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optim
P1.6.4	Field WeakngPnt	8.00	320.00	Hz	60.00	602	Field weakening point
P1.6.5	Voltage at FWP	10.00	200.00	%	100.00	603	Motor voltage (%*NotorNomVoltage) at field weakening point
P1.6.6	V/Hz Mid Freq	0.00	Field Weakening Point	Hz	60.00	604	Programmable U/F curve middle point frequency
P1.6.7	V/Hz Mid Voltg	0.00	100.00	%	100.00	605	Motor voltage (%*MotorNomVoltage) at programmable U/F curve middle point

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-7: Motor Control Parameters — M1 → G1.6, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.8	Zero Freq Voltg	0.00	40.00	%	1.50	606	Motor voltage (%*MotorNomVoltage) at programmable U/F curve zero point
P1.6.9	Switching Freq	1.0	Switching FreqMax	kHz	10.0	601	Switching frequency in kHz (depends on drive hp rating)
P1.6.10	Overvolt Contr	0	2		1	607	**0** = Off **1** = On with no ramping **2** = On with ramping
P1.6.11	Undervolt Contr	0	1		1	608	**0** = Off **1** = On
P1.6.12	LoadDrooping	0.00	100.00	%	0.00	620	[W] Load Drooping (0 …10000) = 0 … 100% of nominal speed at nominal torque.
P1.6.13	Identification	0	2		0	631	**0** = ID run **1** = Overload V/f ratio **2** = Overload V/f plus boost

Protections — M1 → G1.7

Table 9-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.1	4mA Fault Resp	0	5		4	700	Response to reference fault: **0** = No action **1** = Warning **2** = Warning, old frequency **3** = Warning, preset frequency **4** = Fault, stop according to P1.4.7 **5** = Fault, stop always by coasting
P1.7.2	4mA Fault Freq.	0.00	Max_ Frequency	Hz	0.00	728	Preset (reference) frequency if reference fault and P1.7.1 = 3
P1.7.3	External Fault	0	3		2	701	Response to external fault: **0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.4	Input Phase Supv	0	3		0	730	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.5	UVolt Fault Resp	0	1		0	727	**0** = Fault stored to History **1** = Fault not stored to History

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.6	OutputPh. Superv	0	3		2	702	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.7	Ground fault	0	3		2	703	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.8	Motor Therm Prot	0	3		2	704	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.9	MotAmbTemp Factor	-100.0	100.0	%	0.0	705	Ambient temperature of the motor (-100.0… 100.0%) 0.0= nominal, 100.0= max.
P1.7.10	MTP f0 Current	0.0	150.0	%	40.0	706	Motor cooling ability at zero speed
P1.7.11	MTP Motor T	1	200	min	45	707	Motor Thermal Time Constant in minutes
P1.7.12	Motor Duty Cycle	0	100	%	100	708	Motor Duty Cycle in %.
P1.7.13	Stall Protection	0	3		1	709	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.14	Stall Current	Motor CurrentMin	Motor CurrentMax	A	Motor Nom Current * 1.3	710	Current limit of motor stall protection (0.1A - [Motor Nom. current * 2])
P1.7.15	Stall Time Lim	1.00	120.00	s	15.00	711	Max time for stall
P1.7.16	Stall Freq Lim	1.00	Max_ Frequency	Hz	25.00	712	Max frequency for stall protection
P1.7.17	Underload Protec	0	3		0	713	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.18	UP fnom Torque	10.0	150.0	%	50.0	714	Underload load curve at nominal frequency
P1.7.19	UP f0 Torque	5.0	150.0	%	10.0	715	Underload load curve at zero frequency
P1.7.20	UP Time Limit	2.00	600.00	s	20.00	716	Time limit for underload supervision

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.21	ThermistorF. Resp	0	3		2	732	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.22	FBComm.Fault Resp	0	3		2	733	Response to Fieldbus fault **0** = No action **1** = Warning **2** = Fault
P1.7.23	SlotComFault Resp	0	3		2	734	Response to option card fault **0** = No action **1** = Warning **2** = Fault
P1.7.24	PT100 Numbers	0	3		0	739	
P1.7.25	PT100 FaultRespo	0	3		0	740	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.26	PT100 Warn.Limit	-30.0	200.0	°C	120.0	741	
P1.7.27	PT100 Fault Lim.	-30.0	200.0	°C	130.0	742	

Auto Restart Parameters — M1 → G1.8

Table 9-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.8.1	Wait Time	0.10	10.00	s	0.50	717	
P1.8.2	Trial Time	0.00	60.00	s	30.00	718	
P1.8.3	Start Function	0	2		1	719	**0** = Ramp **1** = Flying start **2** = System defined
P1.8.4	Undervolt. Tries	0	10	x	0	720	
P1.8.5	Overvolt. Tries	0	10	x	0	721	
P1.8.6	Overcurr. Tries	0	3	x	0	722	
P1.8.7	4mA Fault Tries	0	10	x	0	723	
P1.8.8	MotTempF Tries	0	10	x	0	726	
P1.8.9	Ext.Fault Tries	0	10	x	0	725	
P1.8.10	Underload tries	0	10	x	0	738	

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Fire Mode Parameters — M1 → G1.9

Table 9-10: Fire Mode Parameters — M1 → G1.9

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.9.1 ①	FireMode Function	0	1		0	1509	Fire mode input function: **0** = Closing contactor **1** = Opening contactor
P1.9.2	FMRef Sel Invert	0	1		0	1510	Fire mode reference selection inversion. Default = Not Inverted.
P1.9.3	FireMode MinFreq	Min_ Frequency	FreqMax	Hz	15.00	1511	Fire mode minimum frequency. Default = 15.00Hz.
P1.9.4	FireMode Ref. 1	0.0	100.0	%	75.0	1512	Fire mode frequency reference 1. Default = 75.0% of P1.1.2.
P1.9.5	FireMode Ref. 2	0.0	100.0	%	100.0	1513	Fire mode frequency reference 2. Default = 100.0% of P1.1.2.

① See important ⚠ Warning on Fire Mode operation on **Page 11-43.** Electronic overload must be set to "Auto" versus "Manual" for "emergency operation" and continued running of motor even if electronic overload trips.

Preset Speed Parameters — M1 → G1.10

Table 9-11: Preset Speed Parameters — M1 → G1.10

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.10.1	Preset Speed 1	0.0	100.0	%	15.0	1514	Preset speed 1 reference. Percentages of maximum frequency. Default = 15.0%.
P1.10.2	Preset Speed 2	0.0	100.0	%	30.0	1515	Preset speed 2 reference. Percentages of maximum frequency. Default = 30.0%.
P1.10.3	Preset Speed 3	0.0	100.0	%	45.0	1516	Preset speed 3 reference. Percentages of maximum frequency. Default = 45.0%.
P1.10.4	Preset Speed 4	0.0	100.0	%	60.0	1517	Preset speed 4 reference. Percentages of maximum frequency. Default = 60.0%.
P1.10.5	Preset Speed 5	0.0	100.0	%	75.0	1518	Preset speed 5 reference. Percentages of maximum frequency. Default = 75.0%.
P1.10.6	Preset Speed 6	0.0	100.0	%	100.0	1519	Preset speed 6 reference. Percentages of maximum frequency. Default = 00.0%.

Table 9-12: Binary Inputs for Preset Speeds

Preset Speed #	PM Setback DIN On	Preset Speed 1	Preset Speed 2
PM Setback Ref %	1	0	0
1	0	1	0
2	1	1	0
3	0	0	1
4	1	0	1
5	0	1	1
6	1	1	1

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

PID-Control Parameters — M1 → G1.11

Table 9-13: PID-Control Parameters — M1 → G1.11

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.11.1 ①	PID Control	0	1		0	1523	**0** = Disabled **1** = Enabled
P1.11.2	PIDSetpointSrce	0	4		2	332	**0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Setpoint from Keypad **3** = Fieldbus reference (ProcessDataIN 1) **4** = Motor potentiometer
P1.11.3	Engineering Unit	0	1		0	1926	Selection for PSIG/Bar (0) Engineering units or Percentage (1)
P1.11.4	Setpoint Min.	0/0/0.0%	Setpoint Max	PSIG/ Bar/ %	0/0/0.0%	1524	PID Setpoint Min. Limit
P1.11.5	Setpoint Max.	Setpoint Min.	300/20.7/ 100.0%	PSIG/ Bar/ %	300/20.7/ 100.0%	1525	PID Setpoint Max. Limit
P1.11.6	Act Value Select	0	7		0	333	**0** = Actual value1 **1** = Actual 1 + Actual 2 **2** = Actual 1 - Actual 2 **3** = Actual 1 * Actual 2 **4** = Min. (Actual 1, Actual 2) **5** = Max. (Actual 1, Actual 2) **6** = Mean (Actual 1, Actual 2) **7** = Sqrt (Actual 1) + Sqrt (Actual 2)
P1.11.7	Actual 1 Input	0	8		2	334	**0** = Not used **1** = AI-1 signal (control board) **2** = AI-2 signal (control board) **3** = Fieldbus (ProcessDataIN 2) **4** = Motor torque **5** = Motor speed **6** = Motor current **7** = Motor power **8** = Encoder frequency
P1.11.8	Actual 2 Input	0	8		0	335	**0** = Not used **1** = AI-1 signal (control board) **2** = AI-2 signal (control board) **3** = Fieldbus (ProcessDataIN 3) **4** = Motor torque **5** = Motor speed **6** = Motor current **7** = Motor power **8** = Encoder frequency
P1.11.9	Sensor Min Scale	0/0/0.0%	Sensor_Max _Scale	PSIG/ Bar/ %	0/0/0.0%	1521	Pressure sensor min. scale value

① PID Control can be enabled independently for “Hand” or “Auto” from parameters P1.1.16 and P1.1.18 by using selection 5 PID Control.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Table 9-13: PID-Control Parameters — M1 → G1.11, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.11.10	Sensor Max Scale	Sensor_Min _Scale	2000/138.0/ 100.0%	PSIG/ Bar/ %	500/34.5/ 100.0%	1522	Pressure sensor max. scale value
P1.11.11	Error Inversion	0	1		1	340	**0** = Inverted (reverse acting) **1** = Not inverted (direct acting)
P1.11.12	PID-Contr Gain	0.00	10.00		0.20	118	**0** = No P-part in use
V1.11.13 ①	PID-Contr Gain	0.00	10.00		0.20	1622	**0** = No P-part in use
P1.11.14	PID-Contr I Time	0.00	320.00	s	1.00	119	**320.00 s** = No I-part in use
V1.11.15 ①	PID-Contr I Time	0.00	320.00	s	1.00	1644	**320.00 s** = No I-part in use
P1.11.16	PID-Contr D Time	0.00	100.00	s	0.00	132	PID controller deriv. time **0** = No D part in use
V1.11.17 ①	PID-Contr D Time	0.00	100.00	s	0.00	1688	PID controller deriv. time **0** = No D part in use
P1.11.18	PID Min Limit	-1000.0	PIC_Max_ Limit	%	0.0	359	Minimum value of the PID controller output
P1.11.19	PID Max Limit	PIC_Min_ Limit	1000.0	%	100.0	360	Maximum value of the PID controller output
P1.11.20	Setpnt Rise Time	0.1	100.0	s	5.0	341	Time for reference value change from 0 % to 100 %
P1.11.21	Setpnt Fall Time	0.1	100.0	s	5.0	342	Time for reference value change from 100 % to 0 %
P1.11.22	Sleep Speed Lim.	0.0	100.0	%	15.0	1016	Speed below which the speed of the speed controlled motor has to go before starting the sleep delay counting (0.0 = Not in use)
P1.11.23	Sleep Delay	0	3600	s	60	1017	Time that the speed has to be below sleep speed before stopping the drive.
P1.11.24	Wake Up Limit	Sensor_Min _Scale	Sensor_Max _Scale	PSIG/ Bar /%	171/11.5/ 25.0%	1018	Level of the actual value for restarting the drive.
P1.11.25	Wake Up Action	0	1		1	1019	**0** = Wake up falling below the wake up limit level P1.11.24 **1** = Wake up exceeding the wake up limit level P1.11.24
P1.11.26	MotPotMem PISp.	0	2		0	370	Motor potentiometer (PI setpoint) memory select: **0** = No reset **1** = (Reset, Stop + Powerdown) **2** = Powerdown

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Fieldbus Parameters — M1 → G1.12

Table 9-14: Fieldbus Parameters — M1 → G1.12

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P.1.12.1	FB Data Out1 Sel	0	10000		20	852	PID setpoint
P.1.12.2	FB Data Out2 Sel	0	10000		21	853	PID actual
P.1.12.3	FB Data Out3 Sel	0	10000		23	854	Fan speed %
P.1.12.4	FB Data Out4 Sel	0	10000		22	855	PID error
P.1.12.5	FB Data Out5 Sel	0	10000		13	856	AI 1
P.1.12.6	FB Data Out6 Sel	0	10000		14	857	AI 2
P.1.12.7	FB Data Out7 Sel	0	10000		17	858	DO1, RO1, RO2 status
P.1.12.8	FB Data Out8 Sel	0	10000		26	859	Analog I_{out}
P1.12.9 ②	FLN Address	0	99	1	99	1900	
V1.12.10 ①	FLN Address	0	99	1	99	1589	

① "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values", the parameters can be offset by a couple of consecutive parameter codes.

② Parameter present only if using Siemens Apogee Communications Software.

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 9-15: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	ID Number ①	Description
R2.1	Keypad Reference	0.0	100.0	%	0.0	NA	Keypad reference
R2.2	Condenser Setpoint	PID Setpoint Min.	PID Setpoint Max.	PSIG/ Bar/ %	196/13.5/ 0.0%	NA	PID keypad setpoint
P2.3	Keypad Direction	0	1		0	123	Reverse request active from the panel: **0** = Forward **1** = Reverse
P2.4	StopButton Active	0	1		Yes	114	Stop button (keypad) always active (Yes/No)

① Keypad Control Parameter ID Numbers are listed separately on **Page 11-45**.

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in **Chapter 6**.

BAC Pressure PSIG/Bar Application (SVCHS301/SVCHS303), continued

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See **Chapter 6** — Menu information item M7, for more information.

Table 9-16: Monitoring Menu

Code	Parameter	Min.	Max.	Unit	ID #	Description
V7.1	Fan Speed	-320.00	320.00	Hz	1	Output frequency to motor
V7.2	Condenser Setpoint	0/0/0.0%	300/20.7/ 100.0%	PSIG/ Bar/%	20	PID pressure setpoint
V7.3	Condenser Pressure	0/0/0.0%	300/20.7/ 100.0%	PSIG/ Bar/%	21	Condenser pressure
V7.4	Fan Speed	-100.0	100.0	%	1845	PID output in %
V7.5	PID Error	-2000/-138/ -100.0%	2000/138.0/ 100.0%	PSIG/ Bar/%	22	Error between PID actual and PID setpoint
V7.6	Fan Reference	-320.0	320.0	%	1520	Motor reference in %
V7.7	Frequency Reference	-320.0	320.0	Hz	25	Frequency reference
V7.8	Motor Speed	-10000	10000	rpm	2	Calculated motor speed in rpm
V7.9	Motor Current	0.0	Motor Current Max	A	3	Motor current
V7.10	Motor Torque	-300.0	300.0	%	4	Calculated torque as a % of nominal torque
V7.11	Motor Power	-300.0	300.0	%	5	Calculated motor shaft power
V7.12	Motor Voltage	0.0	1000.0	VAC	6	Calculated motor voltage
V7.13	DC Bus Voltage	0	1000	VDC	7	DC bus voltage
V7.14	Unit Temperature	-50	300	°C	8	Heatsink temperature
V7.15	Motor Temperature	0.0	1000.0	%	9	Calculated motor temperature
V7.16	Analog Input 1	-10.00	20.00	V	13	Analog Input 1
V7.17	Analog Input 2	-10.00	20.00	mA	14	Analog Input 2
V7.18	DIN1 – DIN3 Status	0	7	OFF/ON	15	Status of DIN1 thru DIN3
V7.19	DIN4 – DIN6 Status	0	7	OFF/ON	16	Status of DIN4 thru DIN6
V7.20	DIN Status	0	32000		1904	
V7.21	DO1 – RO2 Status	0	7	OFF/ON	17	Digital and relay output status
V7.22	RO3, RO4, RO5	0	7		1898	
V7.23	Relay Out Status	0	36500		1773	
V7.24	Analog Iout	0.00	20.00	mA	26	Analog output AO 1
V7.25	PT100 temperature	-30.0	200.0	°C	42	Highest temperature of used inputs, needs option board (OPTB8)
G7.26	Multimonitor	—	—	—	—	—

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See **Chapter 6** for more information.

Chapter 10 — Remote Control Application (HVCHS0025)

Introduction

The Remote Control Application of the BAC VFD provides a wide range of parameters for controlling motors. It can be used on a variety of processes, where wide flexibility of I/O signals is needed and PID control is not necessary (if PID control functions are needed, use the other applications).

The frequency reference can be selected e.g. from the analog inputs, joystick control, motor potentiometer and from a mathematical function of the analog inputs. There are also parameters for Fieldbus communication. Multi-step speeds and jog speed can be selected if the digital inputs are programmed for these functions.

- The digital inputs and all of the outputs are freely programmable. The application supports all I/O option boards.

Additional functions:

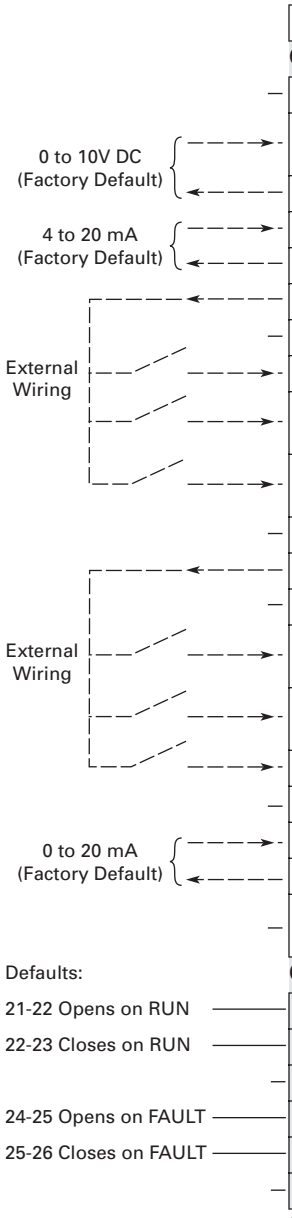
- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start, stop and reverse logic
- DC-brake at start and stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: programmable action; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Joystick hysteresis

Details of the parameters shown in this section are available in **Chapter 11** of this Manual, listed by parameter ID number.

Remote Control Application (HVCHS0025), continued

Control Input/Output

Table 10-1: Remote Control Application Default I/O Configuration

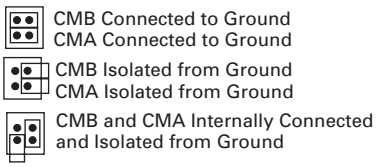


Terminal		Signal	Description
OPTA9			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start/Stop Control	Contact closed = Start
9	DIN2	External fault input (programmable)	Contact closed = Fault Contact open = No fault
10	DIN3	Fault reset (programmable)	Contact closed = Fault reset
11	CMA	Common for DIN1 – DIN3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Vibration Cutout Alarm (programmable)	Contact open = Alarm ①
15	DIN5	Vibration Cutout Fault (programmable)	Contact open = Fault ②
16	DIN6	Overload Relay Fault	Contact closed = Fault
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

① Programmed from Start-Up Wizard or from Parameter P1.1.18 or selection 22, P1.2.6 VibAlmOpen.
② Programmed from Start-Up Wizard or from Parameter P1.1.17 or selection 22, P1.2.7 Vib Fault Open.

Note: For information on jumper selections, see **Page 4-5**.

X3 Jumper Setting — CMA and CMB Grounding


CMB Connected to Ground
CMA Connected to Ground
CMB Isolated from Ground
CMA Isolated from Ground
CMB and CMA Internally Connected
and Isolated from Ground

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

Remote Control Application (HVCHS0025), continued

Parameter Lists

On the next pages, you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 11**.

Column explanations:

Code = Location indication on the keypad; Shows the operator the present parameter number
Parameter = Name of parameter
Min. = Minimum value of parameter
Max. = Maximum value of parameter
Unit = Unit of parameter value; Given if available
Default = Value preset by factory
ID = ID number of the parameter for reference to **Chapter 11**

Basic Parameters — M1 → G1.1

Table 10-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.1	Min Frequency	0.00	Max_ Frequency	Hz	6.00	101	Min. output frequency
P1.1.2	Max Frequency	FreqMin	320.00	Hz	60.00	102	Max. output frequency
P1.1.3	Accel Time 1	0.1	3000.0	s	60.0	103	Time from min. frequency to max. frequency
P1.1.4 ②	Accel Time 1	0.1	3000.0	s	60.0	1690	Time from min. frequency to max. frequency
P1.1.5	Decel Time 1	0.1	3000.0	s	60.0	104	Time from max. frequency to min. frequency
P1.1.6 ②	Decel Time 1	0.1	3000.0	s	60.0	1691	Time from max. frequency to min. frequency
P1.1.7	Motor Nom Voltg	180	690	V	460	110	Motor nominal voltage in volts
P1.1.8	Motor Nom Freq	8.00	320.00	Hz	60.00	111	Motor nominal frequency
P1.1.9	Motor Nom Speed	24	20000	rpm	1760	112	Motor nominal speed in rpm
P1.1.10	Motor Nom Currnt	Motor CurrentMin	Motor CurrentMax	A	Varies	113	Motor nominal current
P1.1.11	Motor Service Factor	0.00	2.00	x	1.15	1685	Motor service factor. This value is multiplied by the motor nominal current to set the current limit.
P1.1.12	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	107	Output current limit
P1.1.13	Current Limit	Motor CurrentMin	Motor CurrentMax	A	Varies	1624	Output current limit
P1.1.14	Power Factor	0.30	1.00		0.85	120	Motor Cos Phii or power factor

① This selection can be used along with a constant "start" signal if automatic restart is desired after a power cycle.
② "Parameters" addressed as "V"X.X.XX are read only and are used only in Temp F, PSIG and Remote Control for Siemens Apogee Communications protocol when locking of panel parameters is required. Also due to the addition of the "Values" the parameters can be offset by a couple of consecutive parameter codes.

Remote Control Application (HVCHS0025), continued

Table 10-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.1.15	Start Srce Hand	1	3		1	171	Parameter for local start/stop control location: Default = Keypad **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire
P1.1.16	Setpoint Source Hand	0	4		2	173	Local frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from Keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer
P1.1.17	Start Srce Auto	1	4		2	172	Parameter for remote start/stop control location. Default = DIN1 start **1** = Keypad **2** = DIN1 start ① **3** = I/O three-wire **4** = Fieldbus
P1.1.18	Setpoint Source Auto	0	4		1	174	Remote frequency reference selection: **0** = Analog input AI-1 **1** = Analog input AI-2 **2** = Reference from Keypad (frequency reference) **3** = FB reference **4** = Motor potentiometer
P1.1.19	PM Setback Ref.	0.0	100.0	%	30.0	1500	PM setback speed reference. Percentages of maximum frequency. Default = 30.0%.
P1.1.20	VCOS Shutdown	No	Yes	–	No	1837	VCOS Vibration cutout switch for drive fault. ②
P1.1.21	VCOS Alarm	No	Yes	–	No	1838	VCOS Vibration cutout alarm switch. ②

① This selection can be used along with a constant "start" signal if automatic restart is desired after a power cycle.

② These two parameters exist in the Start-Up Wizard. When selecting either "no" or "yes", you force P1.2.6 (Slot A, DIN4) or P1.2.7 (Slot A, DIN5) for either selection 21 "no" Vibration Cutout (closed contact) or selection 22 "yes" Vibration Cutout (open contact). If P1.2.6 or P1.2.7 digital inputs are programmed for anything other than the Vibration Cutout, then these two parameters should not be changed, otherwise they will force the selections for DIN4 or DIN5 to "21" or "22".

Remote Control Application (HVCHS0025), continued

Input Signals — M1 → G1.2

Table 10-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.1	Start Function	0	3		0	1501	Start Function: **0** = Normal start from I/O without interlockings. **1** = Interlocked start from I/O. One of the digital/relay outputs must be programmed to value 27 (Interlock) and one of the digital inputs must be programmed to value 20 (Interlock) **2** = Interlocked start + timeout supervision. If feedback doesn't come within the interlock timeout time, start request is ignored and must be given again. **3** = Delayed start from I/O. Start request is given after delay time has expired.
P1.2.2	Intlk Timeout	0.00	300.00	s	5.00	1502	Timeout time for the interlock feedback waiting. Init = 5s.
P1.2.3	Start Delay Time	0.00	300.00	s	5.00	1503	Start delay time. Init = 5s.
P1.2.4	Slot A, DIN2 ExtFaulClose	0	20		1	319	**0** = Stop pulse, when three-wire start/stop logic is selected. (False=Stop, True=Ready to Run) **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accel./decel. time selection **5** = Force ctrl. place to Hand **6** = Fire Mode **7** = Force ctrl. place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Motor potentiometer, Up **14** = Fire mode reference selection **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = PID control, Active **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock

⚠ CAUTION

Unattended start will occur if power is supplied with Start Command activated.

Remote Control Application (HVCHS0025), continued

Table 10-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.5	Slot A, DIN3 Fault Reset	0	20		10	301	**0** = Not used **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Accel./decel. time selection **5** = Force control place to Hand **6** = Fire mode **7** = Force control place to Auto **8** = Reverse **9** = PM Setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Motor potentiometer, Down **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = Reserved **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock
P1.2.6	Slot A, DIN4	0	22		21 ①	1504	Same as Slot A, DIN2, except **21** = Vibration cutout alarm, closing contact **22** = Vibration cutout alarm, opening contact

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN4 will be automatically set to selection 22, open contact.

Remote Control Application (HVCHS0025), continued

Table 10-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.7	Slot A, DIN5	0	22		21 ①	330	**0** = Not used **1** = Ext. fault, closing contact **2** = External fault, opening contact **3** = Run/enable **4** = Acceler./deceler. time selection **5** = Force control place to Hand **6** = Fire Mode **7** = Force control place to Auto **8** = Reverse **9** = PM setback **10** = Fault reset **11** = Accel./decel. operation prohibit **12** = DC braking command **13** = Enable PID setpoint 2 **14** = Fire mode reference activation **15** = Fire mode reference selection P1.9.4/P1.9.5 **16** = Reserved **17** = Preset speed selection 1 **18** = Preset speed selection 2 **19** = Enable bypass **20** = Interlock **21** = Vibration cutout fault, closing contact **22** = Vibration cutout fault, opening contact
P1.2.8	Slot A, DIN6	0	19		6	1505	Same as Slot A, DIN3, except **0** = Overload relay (automatic) and **19** = Interlock (no force bypass)
P1.2.9	AI-1 Signal Range	0	2		0	320	**0** = 0 – 100% **1** = 4 mA 20 – 100% **2** = Custom setting range
P1.2.10	AI-1 Custom Min	-160.00	160.00	%	0.00	321	
P1.2.11	AI-1 Custom Max	-160.00	160.00	%	100.00	322	
P1.2.12	AI-1 Signal Inv	0	1		0	323	**0** = Not inverted **1** = Inverted
P1.2.13	AI-1 Filter Time	0.00	10.00	s	0.10	324	**0** = No filtering
P1.2.14	AI-2 Signal Range	0	2		1	325	**0** = 0 - 20 mA **1** = 4 - 20 mA **2** = Custom setting range
P1.2.15	AI-2 Custom Min	-160.00	160.00	%	0.00	326	
P1.2.16	AI-2 Custom Max	-160.00	160.00	%	100.00	327	
P1.2.17	AI-2 Signal Inv	0	1		0	328	**0** = Not inverted **1** = Inverted
P1.2.18	AI-2 Filter Time	0.00	10.00	s	0.10	329	**0** = No filtering

① When VCOS Sensor selected as "YES" in either the Start-Up Wizard or directly via P1.1.17 in Basic Parameters, DIN5 will be automatically set to selection 22, open contact.

Remote Control Application (HVCHS0025), continued

Table 10-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.2.19	MotPot Ramp Time	0.1	2000.0	/s	10.0	331	
P1.2.20	MotPotMemFreq Ref	0	2		1	367	Motorpotentiometer (frequency reference) memory select: **0** = No Action **1** = (Reset, Stop + Powerdown) **2** = Powerdown
P1.2.21	Ref. Scale Min	0.00	320.00	Hz	0.00	344	Selects the frequency that corresponds to the min. reference signal
P1.2.22	Ref. Scale Max	0.00	320.00	Hz	0.00	345	Selects the frequency that corresponds to the max. reference signal

Output Signals — M1 → G1.3

Table 10-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.1	Iout Content	0	10		1	307	Analog output function: **0** = Not used (scale 100%) **1** = O/P frequency (0 - f max) **2** = Reference frequency (0 - f max) **3** = Motor speed (0 - 100% x Motor nom. speed) **4** = O/P current (0 - 100% x I nMot) **5** = Motor torque (0 - 100% x T nMot) **6** = Motor power (0 - 100% x P nMot) **7** = Motor voltage (0 - 100% x U nMot) **8** = DC bus voltage (0 - 100% x U nMot) **9** = PT100 temperature **10** = Fieldbus Command (FBProcessDataIN4)
P1.3.2	Iout Filter Time	0.00	10.00	s	1.00	308	
P1.3.3	Iout Invert	0	1		0	309	**0** = Not inverted **1** = Inverted
P1.3.4	Iout Minimum	0	1		1	310	**0** = 0 mA **1** = 4 mA
P1.3.5	Iout Scale	10	1000	%	100	311	

Remote Control Application (HVCHS0025), continued

Table 10-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.6	Slot A, DO-1	0	28		1	312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = Drive overheat warning **6** = External fault or warning **7** = Reference fault or warning **8** = Warning **9** = Reversed **10** = Jogging speed selected **11** = At speed **12** = Motor regulator activated **13** = Output frequency limit supervision 1 **14** = Output frequency limit supervision 2 **15** = Torque limit supervision **16** = Reference limit supervision **17** = External brake control **18** = Remote control, Active **19** = Frequency converter temperature limit supervision **20** = Unrequested rotation direction **21** = External brake control inverted **22** = Thermistor fault/warning **23** = Reserved **24** = Fire mode, Active **25** = Hand control, Active **26** = Auto control, Active **27** = Start delay relay (damper control) **28** = Running in bypass
P1.3.7	Slot B, RO-1	0	28		2	313	Same as parameter 1.3.6
P1.3.8	Slot B, RO-2	0	28		3	314	Same as parameter 1.3.6
P1.3.9 ①	Slot D, RO-1	0	28		0	1506	Same as parameter 1.3.6
P1.3.10 ①	Slot D, RO-2	0	28		0	1507	Same as parameter 1.3.6
P1.3.11 ①	Slot D, RO-3	0	28		0	1508	Same as parameter 1.3.6
P1.3.12	Freq Supv Lim 1	0	2		0	315	Frequency limit 1 supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.13	Freq Supv Val 1	0.00	Max_ Frequency	Hz	0.00	316	Frequency limit supervision value 1
P1.3.14	Freq Supv Lim 2	0	2		0	346	Frequency limit 2 supervision function: **0** = Not used **1** = Low limit **2** = High limit

① These parameters do not show up in keypad unless the appropriate option board is installed in Slot D.

Remote Control Application (HVCHS0025), continued

Table 10-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.3.15	Freq Supv Val2	0.00	Max_ Frequency	Hz	0.00	347	Frequency limit supervision value 2
P1.3.16	Torque Supv Lim	0	2		0	348	Torque limit supervision function: 0 = Not used 1 = Low limit 2 = High limit
P1.3.17	Torque Supv Val	0.0	300.0	%	100.0	349	Torque limit supervision value
P1.3.18	Ref Superv Lim	0	2		0	350	Reference limit supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.19	Ref Superv Value	0.0	100.0	%	0.0	351	Reference limit supervision value
P1.3.20	Ext Brake OffDel	0.0	100.0	s	0.5	352	Ext brake Off delay
P1.3.21	Ext Brake OnDel	0.0	100.0	s	1.5	353	Ext brake On delay
P1.3.22	Temp Limit Supv	0	2		0	354	Temperature limit supervision function: **0** = Not used **1** = Low limit **2** = High limit
P1.3.23	Temp Supv Value	-10	75	°C	40	355	Temperature limit supervision value

Remote Control Application (HVCHS0025), continued

Drive Control Parameters — M1 → G1.4

Table 10-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.4.1	Ramp 1 Shape	0.0	10.0	s	0.0	500	Accel./decel. ramp 1 shape: **0** = Linear **>0** = S-curve accel./decel. ratio
P1.4.2	Ramp 2 Shape	0.0	10.0	s	0.0	501	Accel./decel. ramp 2 shape: **0** = Linear **>0** = S-curve accel./decel. ratio
P1.4.3 ①	Accel Time 2	0.1	3000.0	s	2.0	502	Acceleration time 2: Time from min. frequency to max. frequency
P1.4.4 ①	Decel Time 2	0.1	3000.0	s	2.0	503	Deceleration time 2: Time from max. frequency to min. frequency
P1.4.5	Brake Chopper	0	4		0	504	Brake chopper mode selection: **0** = Brake NO, Test NO **1** = Brake YES (Run), Test YES (Ready + Run) **2** = Brake chopper EXTERNAL, Test NO **3** = Brake YES (Ready + Run), Test YES (Ready + Run) **4** = Brake YES (Run), Test NO
P1.4.6	Start Function	0	1		0	505	**0** = Ramp **1** = Flying start
P1.4.7	Stop Function	0	1		0	506	**0** = Coasting **1** = Ramp
P1.4.8	DC-Brake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	507	DC brake current
P1.4.9	Stop DC-BrakeTm	0.00	600.00	s	0.00	508	DC brake time [s] in ramp stop
P1.4.10	Stop DC-BrakeFr	0.10	10.00	Hz	1.50	515	DC brake is allowed under this frequency limit
P1.4.11	Start DC-BrakeTm	0.00	600.00	s	0.00	516	[W] DC brake time [ms] in ramp start. Init = 0.
P1.4.12	Flux Brake	0	1		0	520	**1** = flux braking is enabled.
P1.4.13	FluxBrake Current	Motor CurrentMin	Motor CurrentMax	A	MotorNom Current	519	Flux brake current. Default = MotorNomCurrent.

① Accel Time 2 and Decel Time 2 are used when PID control is active.

Remote Control Application (HVCHS0025), continued

Skip Frequencies — M1 → G1.5

Table 10-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.5.1	Range 1 High Lim	0.00	Max_ Frequency	Hz	0.00	510	Skip frequency range 1 high limit: **0** = No prohibit frequency range
P1.5.2	Range 1 Low Lim	0.00	Range_1_ High_Lim	Hz	0.00	509	Skip frequency range 1 low limit
P1.5.3	Range 2 High Lim	0.00	Max_ Frequency	Hz	0.00	512	Skip frequency range 2 high limit: **0** = No prohibit frequency range
P1.5.4	Range 2 Low Lim	0.00	Range_2_ High_Lim	Hz	0.00	511	Skip frequency range 2 low limit
P1.5.5	Range 3 High Lim	0.00	Max_ Frequency	Hz	0.00	514	Skip frequency range 3 high limit: **0** = No prohibit frequency range
P1.5.6	Range 3 Low Lim	0.00	Range_3_ High_Lim	Hz	0.00	513	Skip frequency range 3 low limit
P1.5.7	PH Acc/Dec Ramp	0.1	10.0	x	1.0	518	Accel./decel. ramp scaling ratio between prohibit frequency limits

Motor Control Parameters — M1 → G1.6

Table 10-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.1	Motor Ctrl Mode	0	Control ModeMax		0	600	Motor control mode: **0** = Frequency control **1** = Speed control
P1.6.2	V/Hz Optim.	0	1		0	109	U/F optimization selection: **0** = None **1** = Automatic torque boost
P1.6.3	V/Hz Ratio	0	3		0	108	U/F ratio selection: **0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optim
P1.6.4	Field WeakngPnt	8.00	320.00	Hz	60.00	602	Field weakening point
P1.6.5	Voltage at FWP	10.00	200.00	%	100.00	603	Motor voltage (%*NotorNomVoltage) at field weakening point
P1.6.6	V/Hz Mid Freq	0.00	Field Weakening Point	Hz	60.00	604	Programmable U/F curve middle point frequency
P1.6.7	V/Hz Mid Voltg	0.00	100.00	%	100.00	605	Motor voltage (%*MotorNomVoltage) at programmable U/F curve middle point

Remote Control Application (HVCHS0025), continued

Table 10-7: Motor Control Parameters — M1 → G1.6, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.6.8	Zero Freq Voltg	0.00	40.00	%	1.50	606	Motor voltage (%*MotorNomVoltage) at programmable U/F curve zero point
P1.6.9	Switching Freq	1.0	Switching FreqMax	kHz	10.0	601	Switching frequency in kHz Depends on drive hp rating
P1.6.10	Overvolt Contr	0	2		1	607	**0** = Off **1** = On with no ramping **2** = On with ramping
P1.6.11	Undervolt Contr	0	1		1	608	**0** = Off **1** = On
P1.6.12	LoadDrooping	0.00	100.00	%	0.00	620	[W] Load Drooping (0 …10000) = 0 … 100% of nominal speed at nominal torque.
P1.6.13	Identification	0	2		0	631	**0** = ID run **1** = Overload V/f ratio **2** = Overload V/f plus boast

Protections — M1 → G1.7

Table 10-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.1	4mA Fault Resp	0	5		4	700	Response to reference fault: **0** = No action **1** = Warning **2** = Warning, old frequency **3** = Warning, preset frequency **4** = Fault, stop according to P1.4.7 **5** = Fault, stop always by coasting
P1.7.2	4mA Fault Freq.	0.00	Max_ Frequency	Hz	0.00	728	Preset (reference) frequency if reference fault and P1.7.1 = 3
P1.7.3	External Fault	0	3		2	701	Response to external fault: **0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.4	Input Phase Supv	0	3		0	730	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.5	UVolt Fault Resp	0	1		0	727	**0** = Fault stored to History **1** = Fault not stored to History

Remote Control Application (HVCHS0025), continued

Table 10-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.6	OutputPh. Superv	0	3		2	702	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.7	Ground fault	0	3		2	703	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.8	Motor Therm Prot	0	3		2	704	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.9	MotAmbTemp Factor	-100.0	100.0	%	0.0	705	Ambient temperature of the motor (-100.0… 100.0%) 0.0= nominal, 100.0= max.
P1.7.10	MTP f0 Current	0.0	150.0	%	40.0	706	Motor cooling ability at zero speed
P1.7.11	MTP Motor T	1	200	min	45	707	Motor thermal time constant in minutes
P1.7.12	Motor Duty Cycle	0	100	%	100	708	Motor duty cycle in %
P1.7.13	Stall Protection	0	3		1	709	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.14	Stall Current	Motor CurrentMin	Motor CurrentMax	A	Motor Nom Current * 1.3	710	Current limit of motor stall protection (0.1A - [Motor Nom. current * 2])
P1.7.15	Stall Time Lim	1.00	120.00	s	15.00	711	Max. time for stall
P1.7.16	Stall Freq Lim	1.00	Max_ Frequency	Hz	25.00	712	Max. frequency for stall protection
P1.7.17	Underload Protec	0	3		0	713	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.18	UP fnom Torque	10.0	150.0	%	50.0	714	Underload load curve at nominal frequency
P1.7.19	UP f0 Torque	5.0	150.0	%	10.0	715	Underload load curve at zero frequency

Remote Control Application (HVCHS0025), continued

Table 10-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.7.20	UP Time Limit	2.00	600.00	s	20.00	716	Time limit for underload supervision
P1.7.21	ThermistorF. Resp	0	3		2	732	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.22	FBComm.Fault Resp	0	3		2	733	Response to fieldbus fault **0** = No action **1** = Warning **2** = Fault
P1.7.23	SlotComFault Resp	0	3		2	734	Response to option card fault **0** = No action **1** = Warning **2** = Fault
P1.7.24	PT100 Numbers	0	3		0	739	
P1.7.25	PT100 FaultRespo	0	3		0	740	**0** = No action **1** = Warning **2** = Fault, stop according to P1.4.7 **3** = Fault, stop always by coasting
P1.7.26	PT100 Warn.Limit	-30.0	200.0	°C	120.0	741	
P1.7.27	PT100 Fault Lim.	-30.0	200.0	°C	130.0	742	

Auto Restart Parameters — M1 → G1.8

Table 10-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.8.1	Wait Time	0.10	10.00	s	0.50	717	
P1.8.2	Trial Time	0.00	60.00	s	30.00	718	
P1.8.3	Start Function	0	2		1	719	**0** = Ramp **1** = Flying start **2** = System defined
P1.8.4	Undervolt. Tries	0	10	x	0	720	
P1.8.5	Overvolt. Tries	0	10	x	0	721	
P1.8.6	Overcurr. Tries	0	3	x	0	722	
P1.8.7	4mA Fault Tries	0	10	x	0	723	
P1.8.8	MotTempF Tries	0	10	x	0	726	
P1.8.9	Ext.Fault Tries	0	10	x	0	725	
P1.8.10	Underload tries	0	10	x	0	738	

Remote Control Application (HVCHS0025), continued

Fire Mode Parameters — M1 → G1.9

Table 10-10: Fire Mode Parameters — M1 → G1.9

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P1.9.1 ①	FireMode Function	0	1		0	1509	Fire mode input function: **0** = Closing Contactor **1** = Opening Contactor
P1.9.2	FMRef Sel Invert	0	1		0	1510	Fire mode reference selection inversion. Default = Not Inverted.
P1.9.3	FireMode MinFreq	Min_ Frequency	FreqMax	Hz	15.00	1511	Fire mode minimum frequency. Default = 15.00 Hz.
P1.9.4	FireMode Ref. 1	0.0	100.0	%	75.00	1512	Fire mode frequency reference 1. Default = 75.0% of P1.1.2.
P1.9.5	FireMode Ref. 2	0.0	100.0	%	100.0	1513	Fire mode frequency reference 2. Default = 100.0% of P1.1.2.

① See Important ⚠ Warning on Fire Mode operation on **Page 11-43**. Electronic overload must be set to "Auto" versus "Manual" for "emergency operation" and continued running of motor even if electronic overload trips.

Preset Speed Parameters — M1 → G1.10

Table 10-11: Preset Speed Parameters — M1 → G1.10

Code	Pmeter	Min.	Max.	Unit	Default	ID Number	Description
P1.10.1	Preset Speed 1	0.0	100.0	%	15.0	1514	Preset speed 1 reference. Percentages of maximum frequency. Default = 15.0%.
P1.10.2	Preset Speed 2	0.0	100.0	%	30.0	1515	Preset speed 2 reference. Percentages of maximum frequency. Default = 30.0%.
P1.10.3	Preset Speed 3	0.0	100.0	%	45.0	1516	Preset speed 3 reference. Percentages of maximum frequency. Default = 45.0%.
P1.10.4	Preset Speed 4	0.0	100.0	%	60.0	1517	Preset speed 4 reference. Percentages of maximum frequency. Default = 60.0%.
P1.10.5	Preset Speed 5	0.0	100.0	%	75.0	1518	Preset speed 5 reference. Percentages of maximum frequency. Default = 75.0%.
P1.10.6	Preset Speed 6	0.0	100.0	%	100.0	1519	Preset speed 6 reference. Percentages of maximum frequency. Default = 100.0%.

Table 10-12: Binary Inputs for Preset Speeds

Preset Speed #	PM Setback DIN On	Preset Speed 1	Preset Speed 2
PM Setback Ref %	1	0	0
1	0	1	0
2	1	1	0
3	0	0	1
4	1	0	1
5	0	1	1
6	1	1	1

Remote Control Application (HVCHS0025), continued

Fieldbus Parameters — M1 → G1.11

Table 10-13: Fieldbus Parameters — M1 → G1.11

Code	Parameter	Min.	Max.	Unit	Default	ID Number	Description
P.1.11.1	FB Data Out1 Sel	0	10000		1	852	Output frequency in Hz
P.1.11.2	FB Data Out2 Sel	0	10000		2	853	Motor speed in rpm
P.1.11.3	FB Data Out3 Sel	0	10000		3	854	Motor current in amps
P.1.11.4	FB Data Out4 Sel	0	10000		4	855	Motor torque in %
P.1.11.5	FB Data Out5 Sel	0	10000		5	856	Motor power in %
P.1.11.6	FB Data Out6 Sel	0	10000		6	857	Motor voltage in VAC
P.1.11.7	FB Data Out7 Sel	0	10000		7	858	DC bus voltage in VDC
P.1.11.8	FB Data Out8 Sel	0	10000		37	859	Active fault code
P1.12.9	FLN Address	0	99	1	99	1900	
V1.12.10	FLN Address	0	99	1	99	1589	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 10-14: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	ID Number ①	Description
R2.1	Keypad Reference	0.0	100.0	%	0.0	NA	Keypad reference
P2.2	Keypad Direction	0	1		0	123	Reverse request active from the panel: **0** = Forward **1** = Reverse
P2.3	StopButton Active	0	1		TRUE	114	Stop button (keypad) always active (Yes/No)

① Keypad Control Parameter ID Numbers are listed separately on **Page 11-45**.

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in **Chapter 6**.

Remote Control Application (HVCHS0025), continued

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See **Chapter 6** — Menu information item M7, for more information.

Table 10-15: Monitoring Menu

Code	Parameter	Min.	Max.	Unit	ID #	Description
V7.1	Fan Speed	-320.0	320.0	Hz	1	Output frequency to motor
V7.2	Fan Speed	-100.0	100.0	%	23	PID output in %
V7.3	Fan Reference	-320.0	320.0	%	1520	Motor reference in %
V7.4	Frequency Reference	-320.0	320.0	Hz	25	Frequency reference
V7.5	Motor Speed	-10000	10000	rpm	2	Calculated motor speed in rpm
V7.6	Motor Current	0.0	Motor Current Max	A	3	Motor current
V7.7	Motor Torque	-300.0	300.0	%	4	Calculated torque as a % of nominal torque
V7.8	Motor Power	-300.0	300.0	%	5	Calculated motor shaft power
V7.9	Motor Voltage	0.0	1000.0	VAC	6	Calculated motor voltage
V7.10	DC Bus Voltage	0	1000	VDC	7	DC bus voltage
V7.11	Unit Temperature	-50	300	°C	8	Heatsink temperature
V7.12	Motor Temperature	0.0	1000.0	%	9	Calculated motor temperature
V7.13	Analog Input 1	-10.00	20.00	V	13	Analog Input 1
V7.14	Analog Input 2	-10.00	20.00	mA	14	Analog Input 2
V7.15	DIN1 – DIN3 Status	0	7	OFF/ON	15	Status of DIN1 thru DIN3
V7.16	DIN4 – DIN6 Status	0	7	OFF/ON	16	Status of DIN4 thru DIN6
V7.17	DIN Status	0	32000		1904	
V7.18	DO1, RO1, RO2 Status	0	7	OFF/ON	17	Digital and relay output status
V7.19	RO3, RO4, RO5	0	7		1898	
V7.20	Relay Out Status	0	36500		1773	
V7.21	Analog Iout	0.00	20.00	mA	26	Analog output AO 1
V7.22	PT100 temperature	-30.0	200.0	°C	42	Highest temperature of used inputs, needs option board (OPTB8)
G7.23	Multimonitor	—	—	—	—	—

Remote Control Application (HVCHS0025), continued

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See **Chapter 6** for more information.

Table 10-16: Operate Menu Items

Code	Parameter	Unit	Description
O1	Fan speed	Hz	Output frequency to motor
O2	Fan speed	%	
O3	Fan reference	%	
O4	Frequency reference	Hz	Reference frequency to drive
O5	Motor speed	rpm	Calculated motor speed in rpm
O6	Motor current	A	Motor current in amps
O7	Motor torque	%	Calculated torque as a % of nominal torque
O8	Motor power	%	Calculated motor shaft power
O9	Motor voltage	V	Calculated motor voltage
O10	DC Bus voltage	V	DC bus voltage
O11	Unit temperature	°C	Heatsink temperature
O12	Motor temperature	%	Calculated motor temperature
O13	Multimonitor	—	—

Chapter 11 — Description of Parameters

Parameters by ID Number

On the following pages you will find the parameter descriptions arranged according to the individual ID number of the parameter.

101 Minimum frequency
102 Maximum frequency

Defines the frequency limits of the drive. The maximum value for these parameters is 320 Hz.

103 Acceleration time 1
104 Deceleration time 1

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (parameter ID102).

107 Current limit

This parameter determines the maximum motor current from the drive. The parameter value range differs for each power rating.

108 V/Hz ratio selection

Linear:

0 The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor as shown in **Figure 11-1**. A linear V/Hz ratio should be used in constant torque applications. **This default setting should be used if there is no special need for another setting**.

Squared:

1 The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor as shown in **Figure 11-1**. The motor runs under magnetized below the field weakening point and produces less torque and electromechanical noise. A squared V/Hz ratio can be used in applications where the torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

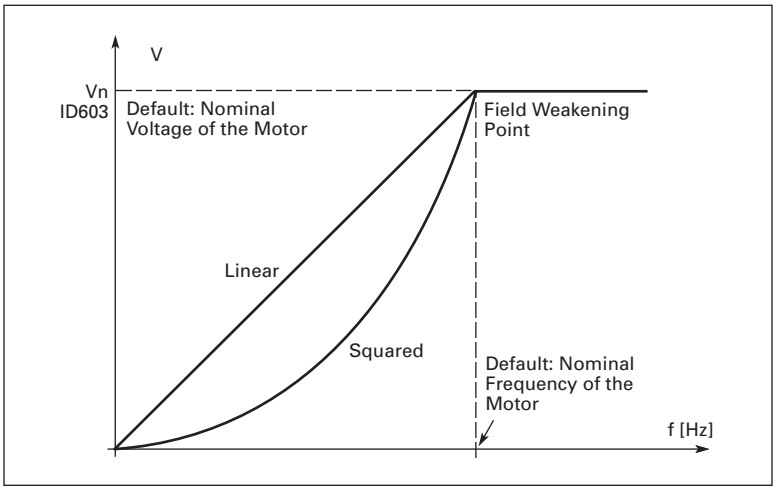


Figure 11-1: Linear and Squared V/Hz Ratio

Programmable V/Hz curve:

2 The V/Hz curve can be programmed with three different points. A programmable V/Hz curve can be used if the other settings do not satisfy the needs of the application.

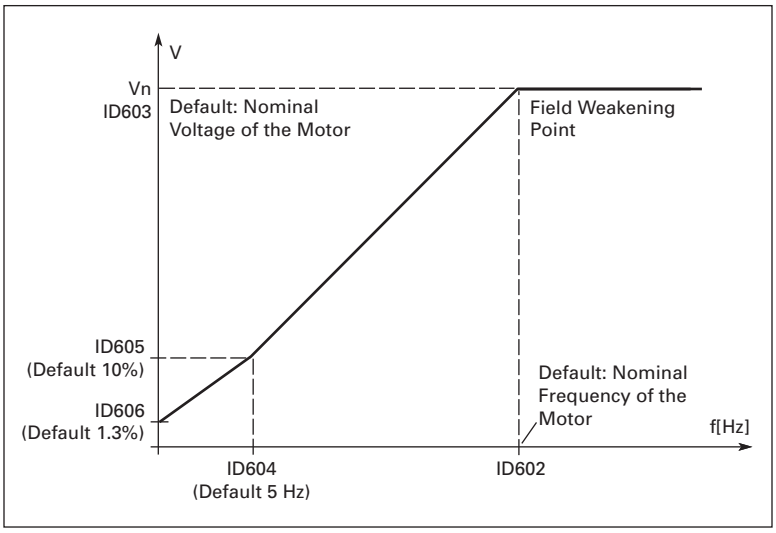


Figure 11-2: Programmable V/Hz Curve

Linear with flux optimization:

3 The drive starts to search for the minimum motor current in order to save energy, lower the disturbance level and the noise. This function can be used in applications with constant motor load, such as fans, pumps etc.

109 V/Hz optimization

Automatic torque boost The voltage to the motor changes automatically which makes the motor produce sufficient torque to start and run at low frequencies. The voltage increase depends on the motor type and rating. Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors.

Example 1:

What changes are required to start the load from 0 Hz?

- First set the motor nominal values (Parameter group 1.1).

Option 1: Activate the Automatic torque boost.

Option 2: Programmable V/Hz curve

To obtain the required torque, the zero point voltage and midpoint voltage/frequency (in parameter group 1.6) need to be set, so that the motor can draw enough current at the low frequencies. First set parameter ID108 to *Programmable V/Hz curve* (value **2**). Increase the zero point voltage (ID606) to get enough current at zero speed. Then set the midpoint voltage (ID605) to 1.4142*ID606 and the midpoint frequency (ID604) to ID606/100%*ID111.

Note: In high torque — low speed applications — it is likely that the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high.

110 Nominal voltage of the motor

Find this value V_n on the motor nameplate. This parameter sets the voltage at the field weakening point (ID603) to 100% * V_{nMotor}.

111 Nominal frequency of the motor

Find this value f_n on the motor nameplate. This parameter sets the field weakening point (ID602) to the same value.

112 Nominal speed of the motor

Find this value n_n on the motor nameplate.

113 Nominal current of the motor

Find this value I_n on the motor nameplate.

118 PID controller gain

This parameter defines the gain of the PID controller. If the value of the parameter is set to 1.00 a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to **0** the PID controller operates as ID-controller. See the examples in ID132.

119 PID controller I-time

This parameter defines the integration time of the PID controller. If this parameter is set to 1.00 second, a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to 0.00 second the PID controller will operate as PD controller. See the examples on in ID132.

120 Motor power factor

Find this value "Power Factor" on the motor nameplate.

132 PID controller D-time

ID132 defines the derivative time of the PID controller. If this parameter is set to 1.00 second a change of 10% in the error value during 1.00 second causes the controller output to change by 10.00%. If the parameter value is set to 0.00 second the PID controller will operate as PID controller. See examples below.

Example 1:

In order to reduce the error value to zero, with the given values, the drive output behaves as follows:

Given values:

P1.1.9 = 1.00
P1.1.10, I-time = 1.00 s
P1.1.11, D-time = 0.00 s — Min freq. = 0 Hz
Error value (setpoint – process value) = 10.00% — Max freq. = 60 Hz

In this example, the PID controller operates practically as an I-controller only. According to the given value of P1.1.10 (I-time), the PID output increases by 6 Hz (10% of the difference between the maximum and minimum frequency) every second until the error value is 0. See **Figure 11-1**.

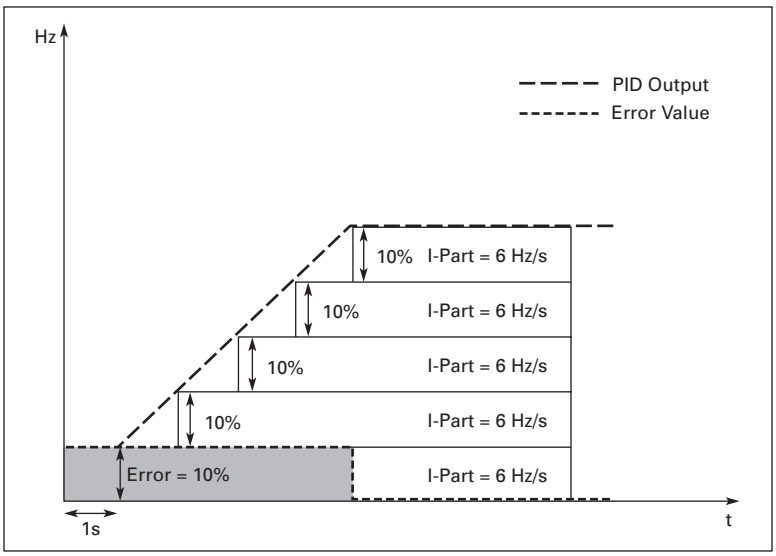


Figure 11-3: PID Controller Function as I-Controller

Example 2:

Given values:

P1.1.9, P = 1.00
P1.1.10, I-time = 1.00 s
P1.1.11, D-time = 1.00 s — Min freq. = 0 Hz
Error value (setpoint – process value) = ±10% — Max freq. = 60 Hz

As the power is switched on, the system detects the difference between the setpoint and the actual process value and starts to either raise or decrease (in case the error value is negative) the PID output according to the I-time. Once the difference between the setpoint and the process value has been reduced to 0, the output is reduced by the amount corresponding to the value of P1.1.9.

In case the error value is negative, the frequency converter reacts reducing the output correspondingly. See **Figure 11-4**.

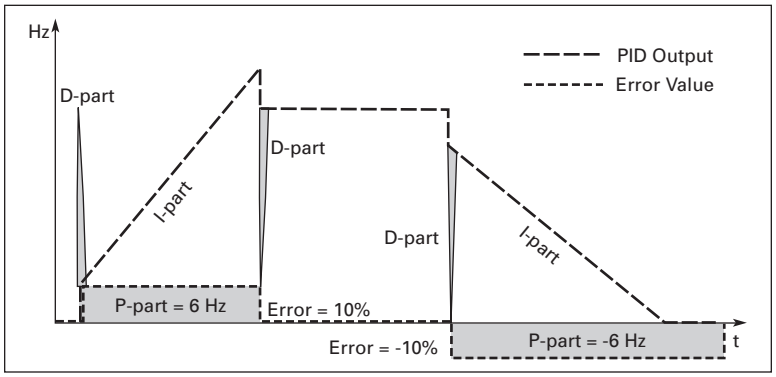


Figure 11-4: PID Output Curve with the Values of Example 2

Example 3:

Given values:

P1.1.9, P = 1.00
P1.1.10, I-time = 0.00 s
P1.1.11, D-time = 1.00 s — Min freq. = 0 Hz
Error value (setpoint – process value) = ±10%/s — Max freq. = 60 Hz

As the error value increases, the PID output also increases according to the set values (D-time = 1.00 second). See **Figure 11-5**.

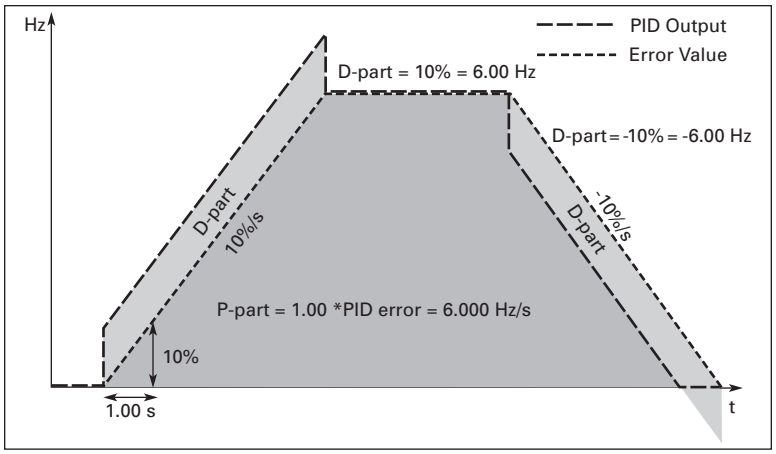


Figure 11-5: PID Output Curve with the Values of Example 3

171 / HAND – OFF – AUTO
172 Control Place

The active control place can be changed by pressing the HOA button on the keypad.

There are two different places which the drive can be controlled from, Local and Remote. For each control place the actual control source is selected with this parameter, a different symbol will appear on the alphanumeric display:

Table 11-1: Selections for IDs 171 and 172

Control source	Symbol
I/O terminals	I/O Term
Keypad	Keypad
Fieldbus	Bus/comm

173 / HAND – OFF – AUTO
174 reference selection

Defines which frequency reference source is selected when controlled from the keypad.
Selection for Parameters ID173 and ID174:

0 Analog voltage ref. Terminals 2 – 3
1 Analog current ref. Terminals 4 – 5
2 Keypad reference (Menu M2)
3 Fieldbus reference
4 Motor potentiometer
5 PID controller ref.

301 DIN3 function

0	Not used
1	External fault, closing contact = Fault is shown and motor is stopped when the input is active
2	External fault, opening contact = Fault is shown and motor is stopped when the input is not active
3	Run enable: contact open = Motor start disabled and the motor is stopped contact closed = Motor start enabled
4	Acc./Dec. time select: contact open = Acceleration/deceleration time 1 selected contact closed = Acceleration/deceleration time 2 selected
5	Closing contact: Force control place to HAND
6	Fire Mode
7	Closing contact: Force control place to AUTO

When the control place is forced to change, the values of Start/Stop, Direction and Reference valid in the respective control place are used (reference according to parameters ID173 and ID174).

Note: When DIN3 opens the control place is selected.

8	Reverse: contact open = Forward contact closed = Reverse **Note:** Can be used for reversing if ID300 has a value of 3.
9	Jog speed, contact closed = Jog speed selected for frequency reference
10	Fault reset, contact closed = Resets all faults
11	Acc./dec. operation prohibited, contact closed = Stops acceleration or deceleration until the contact is opened
12	DC-braking command, contact closed = In Stop mode, the DC-braking operates until the contact is opened, see **Figure 11-6**.
13	Motor potentiometer down, contact closed = Reference decreases until the contact is opened
14	Fire Mode Reference Activation
15	Fire Mode Reference Selection P.1.9.4/P1.9.5
16	PID-Control Active
17	Preset Speed Selection 1
18	Preset Speed Selection 2
19	Force Bypass
20	Interlock

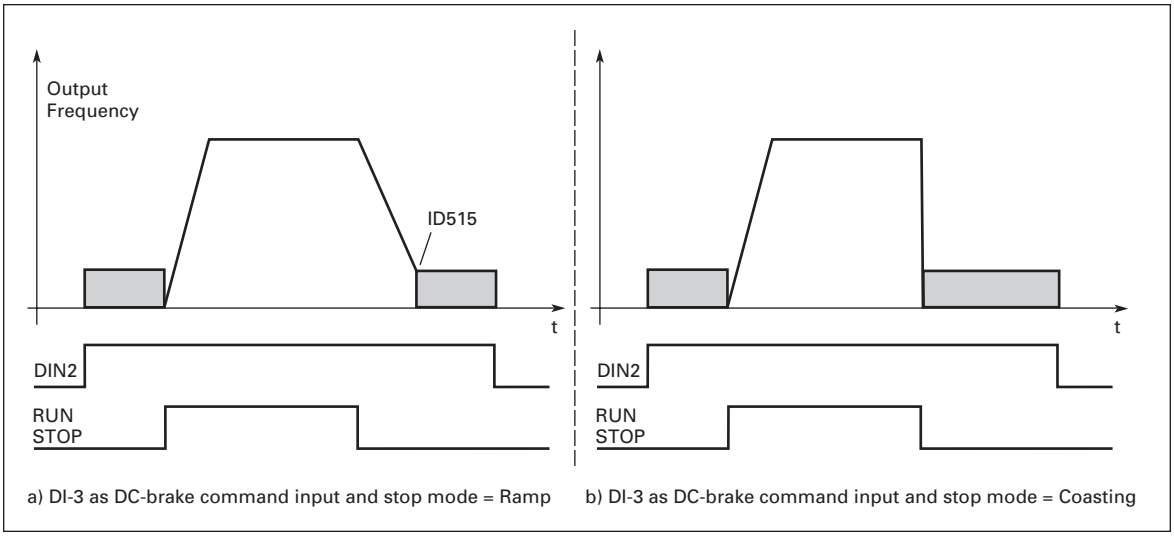


Figure 11-6: DIN3 as DC-Brake Command Input

307 Analog output function

This parameter selects the desired function for the analog output signal. See the specific parameters for the values available in each respective application.

308 Analog output filter time

Defines the filtering time for the analog output signal. Setting this parameter value to **0.00** will deactivate filtering.

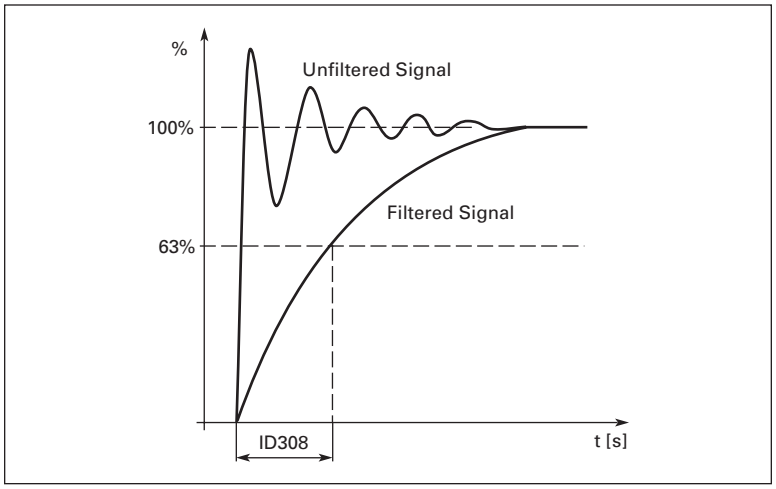


Figure 11-7: Analog Output Filtering

309 Analog output inversion

Inverts the analog output signal:

Maximum output signal = Minimum set value
Minimum output signal = maximum set value

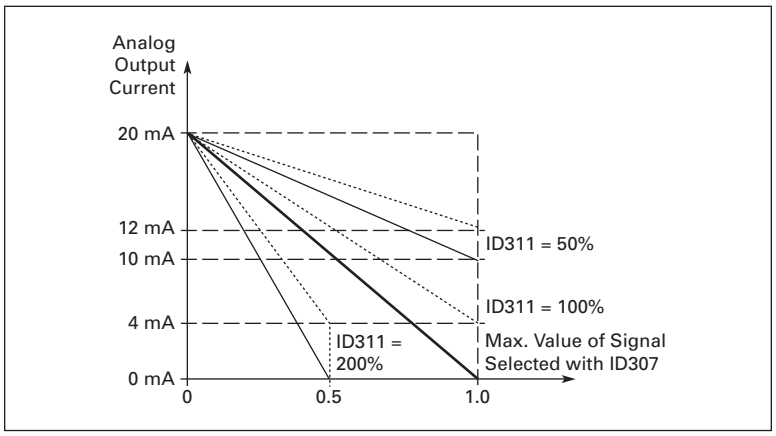


Figure 11-8: Analog Output Invert

310 Analog output minimum

Defines the signal minimum to be either 0 mA or 4 mA ("living zero"). Note the difference in analog output scaling in parameter ID311 (**Figure 11-9**).

0 Set minimum value to 0 mA
1 Set minimum value to 4 mA

311 Analog output scale

Scaling factor for analog output.

Table 11-2: Analog Output Scaling

Signal	Max. value of the signal
Output frequency	Max frequency (ID102)
Freq. Reference	Max frequency (ID102)
Motor speed	Motor nom. speed $1xn_{mMotor}$
Output current	Motor nom. current $1xI_{nMotor}$
Motor torque	Motor nom. torque $1xT_{nMotor}$
Motor power	Motor nom. power $1xP_{nMotor}$
Motor voltage	100% x V_{nMotor}
DC-link voltage PID-ref. value PID act. value 1 PID act. value 2 PID error value PID output	1000 V 100% x ref. value max. 100% x actual value max. 100% x actual value max. 100% x error value max. 100% x output max.

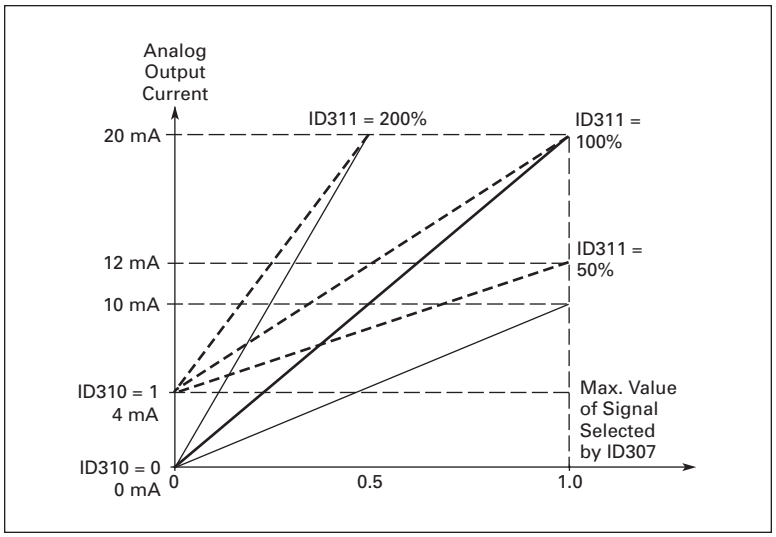


Figure 11-9: Analog Output Scaling

312 Digital output function
313 Relay output 1 function
314 Relay output 2 function

Table 11-3: Output Signals Via DO-1 and Output Relays RO-1 and RO-2

Setting value	Signal content
0 = Not used	Out of operation
Digital output DO-1 sinks current and programmable relay (RO-1, RO-2) is activated when:	
1 = Ready	The drive is ready to operate
2 = Run	The drive is operating (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip not occurred
5 = Overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on ID701
7 = Reference fault or warning	Fault or warning depending on par. ID700 • if analog reference is 4 – 20 mA and signal is <4 mA
8 = Warning	Always if a warning exists
9 = Reversed	The reverse command has been selected
10 = Jog speed	The jog speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency limit supervision	The output frequency is outside the set supervision low limit/high limit (ID315 and ID316)
14 = Output frequency limit 2 supervision	The output frequency goes outside the set supervision low limit/high limit (ID346 and ID347)
15 = Torque limit supervision	The motor torque is beyond the set supervision low limit/ high limit (ID348 and ID349).
16 = Reference limit supervision	Active reference goes beyond the set supervision low limit/ high limit (ID350 and ID351)
17 = External brake control	External brake ON/OFF control with programmable delay (ID352 and ID353)
18 = Reserved	Reserved
19 = Frequency converter temperature limit supervision	Frequency converter heatsink temperature goes beyond the set supervision limits (ID354 and ID355).
20 = Unrequested rotation direction	Rotation direction is different from the requested one.
21 = External brake control inverted	External brake ON/OFF control (ID352 and ID353); Output active when brake control is OFF
22 = Thermistor fault or warning	The thermistor input of option board indicates overtemperature. Fault or warning depending on ID732.
23 = Fieldbus Digital Input 1	Fieldbus input data Digital Input 1.
24 = HAND control active	HAND control active
25 = AUTO control active	AUTO control active
26 = Start delay relay	Start delay relay. Used e.g. with Damper control. See param. 1.2.1 (ID 1501) for more details.

315 Output frequency limit supervision function

0 No supervision
1 Low limit supervision
2 High limit supervision

If the output frequency goes under/over the set limit (ID316) this function generates a warning message via the digital output DO-1 or via the relay outputs RO-1 or RO-2 depending on the settings of parameters ID312 to ID314.

316 Output frequency limit supervision value

Selects the frequency value supervised by parameter ID315. See **Figure 11-10**.

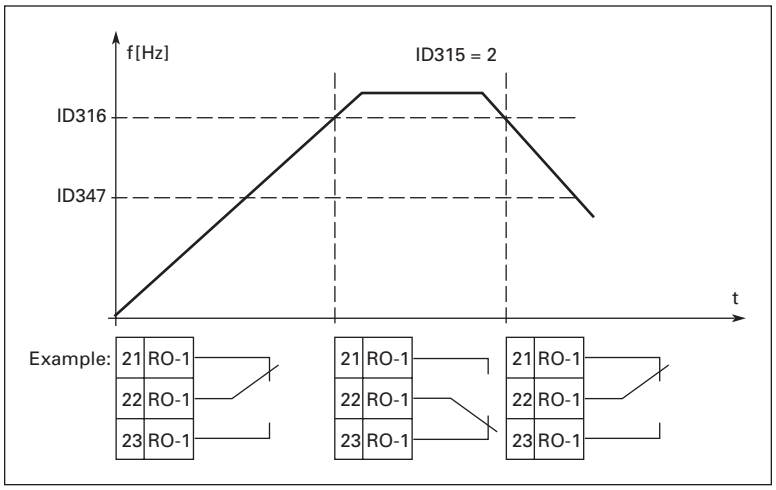


Figure 11-10: Output Frequency Supervision

319 DIN2 function

This parameter has 20 selections. If digital input DIN2 is not used, set this value to **0**.

0	Stop pulse, when 3-wire start/stop selected
1	External fault closed
2	Bypass Ovld Fault
3	Run enable/External interlock – Contact open: Drive start disabled Contact closed: Drive start enabled
4	Acceleration or deceleration time selection – Contact open: Acceleration/Deceleration time 1 selected Contact closed: Acceleration/Deceleration time 2 selected
5	Force ctrl. place to Hand
6	Fire Mode
7	Force ctrl. place to Auto
8	Reverse
9	PM Setback
10	Fault reset
11	Acc./dec. operation prohibit
12	DC-braking command
13	Motor potentiometer UP
14	Fire Mode Reference Activation
15	Fire Mode Reference Select – Contact open or closed based on FMRefSelFunction. If this input is “ON”, then FireModeFreqRef1 or FireModeFreqRef2 is selected as a “Preset Speed.”
16	PID control active
17	Preset speed 1 selected P1.10.1
18	Preset speed 2 selected P1.10.2
19	Force Bypass
20	Interlock – See parameter P1.2.1 for details

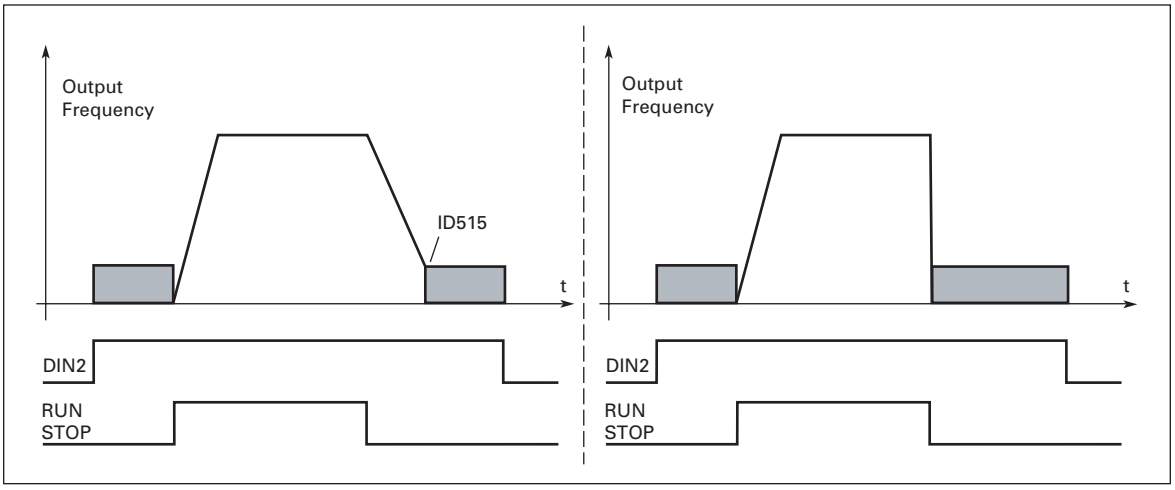


Figure 11-11: DC Braking Command (Selection 12) Selected for DIN2

320 AI-1 signal range

0	0 – 10V
1	2 – 10V
2	Custom

321 AI-1 custom setting minimum

322 AI-1 custom setting maximum

These parameters set the analog input signal for any input signal span within -160.00 to 160.00.

323 AI-1 signal inversion

If this parameter = **0** no inversion of analog V_{in} signal takes place.

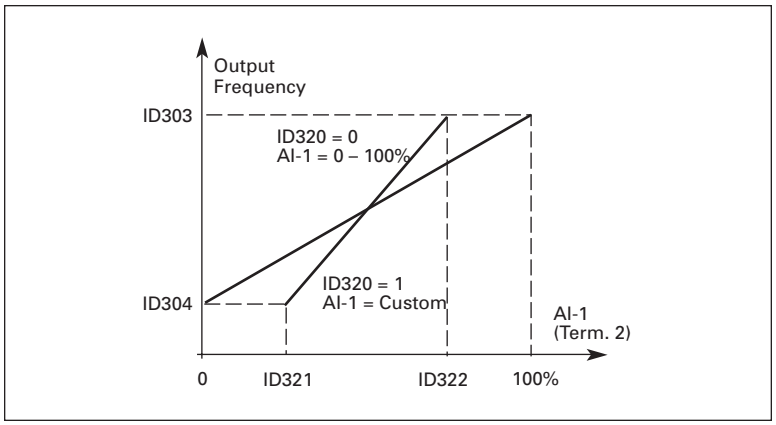


Figure 11-12: AI-1 No Signal Inversion

If this parameter = **1** inversion of analog signal takes place.
max. AI-1 signal = minimum set speed
min. AI-1 signal = maximum set speed

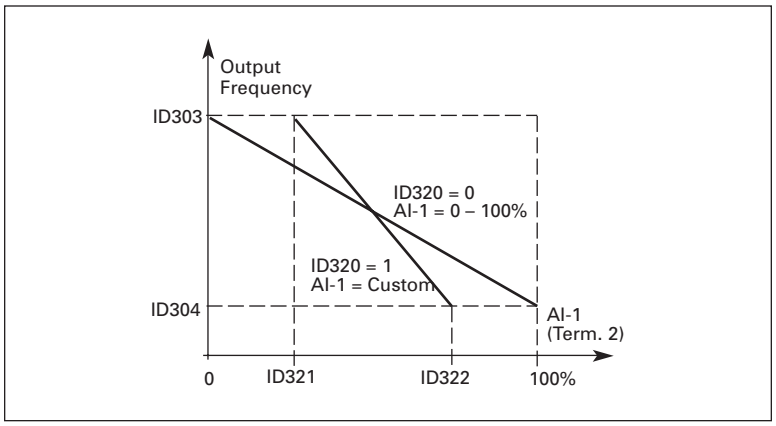


Figure 11-13: AI-1 Signal Inversion

324 AI-1 signal filter time

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analog signal is activated.

A long filtering time makes the regulation response slower. See **Figure 11-14**.

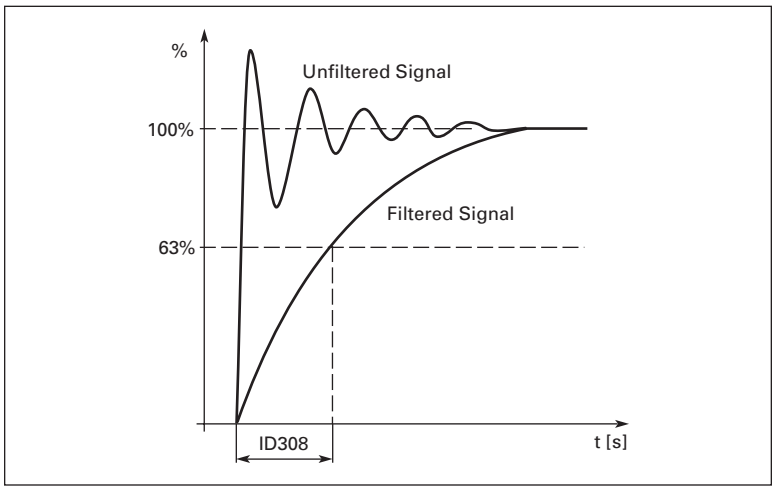


Figure 11-14: AI-1 No Signal Filtering

325 Analog input AI-2 signal range

0 0 – 20 mA
1 4 – 20 mA
2 Customized

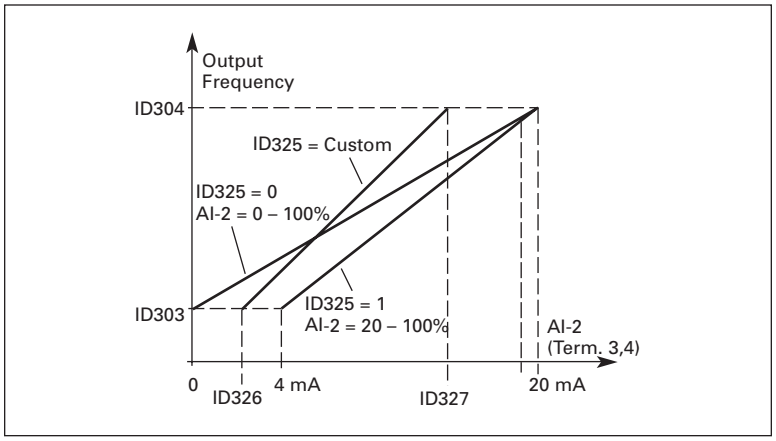


Figure 11-15: Analog Input AI-2 Scaling

326 Analog input AI-2 custom setting min.

327 Analog input AI-2 custom setting max.

These parameters set AI-2 for any input signal span within -160.00 to 160.00.

328 Analog input AI-2 inversion

See ID323.

329 Analog input AI-2 (Iin) filter time

See ID324.

330 DIN5 function

The digital input DIN5 has 20 possible functions. If it is not used, set the value to **0**. The selections are the same as in parameter ID319 except:

13 Enable PID Setpoint 2:
Contact open = PID controller setpoint selected with parameter ID332
Contact closed = PID controller keypad setpoint 2 selected

331 Motor potentiometer ramp time

Defines the speed of change of the motor potentiometer value.

332 PID controller reference signal (Place A)

Defines which frequency reference place is selected for the PID controller.

0 AI-1; terminals 2 – 3
1 AI-2; terminals 4 – 5
2 PID ref. from keypad
3 Fieldbus reference
4 Motor potentiometer reference

333 PID controller actual value selection

This parameter selects the PID controller actual value.

0 Actual value 1
1 Actual value 1 + Actual value 2
2 Actual value 1 – Actual value 2
3 Actual value 1 * Actual value 2
4 Greater one of Actual value 1 and Actual value 2
5 Smaller one of Actual value 1 and Actual value 2
6 Mean value of Actual value 1 and Actual value 2
7 Square root of Actual value 1 + Square root of Actual value 2

334 Actual value 1 selection

335 Actual value 2 selection

0	Not used
1	AI-1 (control board)
2	AI-2 (control board)
3	Fieldbus (*Actual value 1*: FBProcessDataIN2; *Actual value 2*: FBProcessDataIN3)
4	Motor torque
5	Motor speed
6	Motor current
7	Motor power
8	Actual speed from encoder (for Actual value 1 only)

340 PID error value inversion

This parameter allows you to invert the error value of the PID controller (and thus the operation of the PID controller).

0	No inversion
1	Inverted

341 PID Setpoint rise time

Defines the time during which the PID controller reference rises from 0% to 100%.

342 PID Setpoint fall time

Defines the time during which the PID controller reference falls from 100% to 0%.

344 Reference scaling minimum value, place B

345 Reference scaling maximum value, place B

You can choose a scaling range for the frequency reference from control place B between the Minimum and Maximum frequency.

If no scaling is desired set the parameter value to **0.0**.

In **Figure 11-16**, input AI-1 with signal range 0 – 100% is selected for Place B reference.

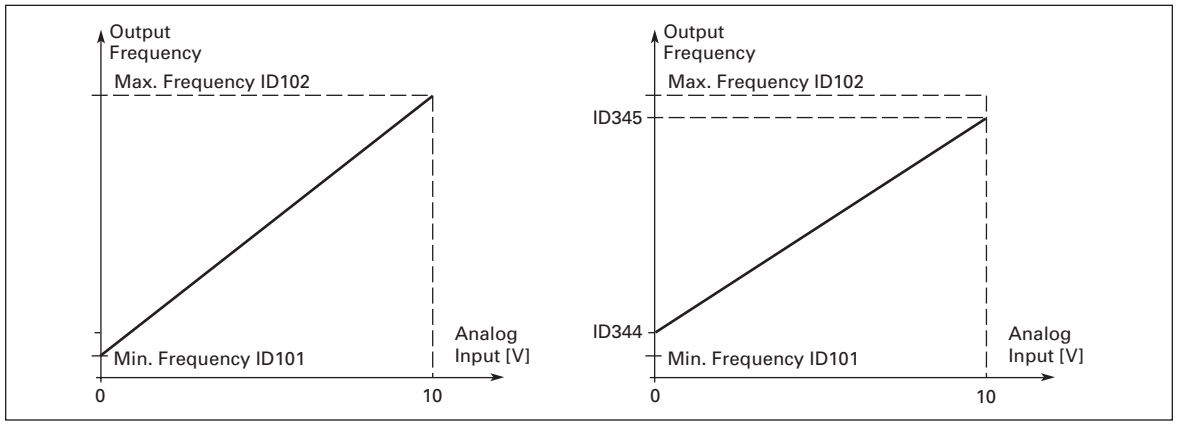


Figure 11-16: Control Place B with and without Reference Scaling

Left: ID344 = 0 (No reference scaling), Right: reference scaling

346 Output freq. limit 2 supervision function

0	No supervision
1	Low limit supervision
2	High limit supervision

If the output frequency goes under/over the set limit (ID347) this function generates a warning message via the digital output DO-1 or relay outputs RO-1 or RO-2 depending on the settings of ID312 to ID314.

347 Output frequency limit 2 supervision value

Selects the frequency value supervised by ID346. See ID316 and ID347 in **Figure 11-10**.

348 Torque limit, supervision function

0	No supervision
1	Low limit supervision
2	High limit supervision

If the calculated torque value falls below or exceeds the set limit (ID349) this function generates a warning message via the digital output DO-1 or via a relay output RO-1 or RO-2 depending on the settings of ID312 to ID314.

349 Torque limit, supervision value

Set here the torque value to be supervised by ID348.

350 Reference limit, supervision function

0	No supervision
1	Low limit supervision
2	High limit supervision

If the reference value falls below or exceeds the set limit (ID351), this function generates a warning message via the digital output DO-1 or via a relay output RO-1 or RO-2 depending on the settings of ID312 to ID314.

The supervised reference is the current active reference. It can be the place A or B reference depending on DIN6 input, or the keypad reference if the keypad is the active control place.

351 Reference limit, supervision value

The frequency value to be supervised by ID350.

352 External brake-off delay

353 External brake-on delay

The function of the external brake can be timed to the start and stop control signals with these parameters. See **Figure 11-17**.

The brake control signal can be programmed via digital output DO-1 or one of the relay outputs RO-1 and RO-2, see ID312 to ID314 (Applications 3, 4, 5) or ID445 (Applications 6 and 7).

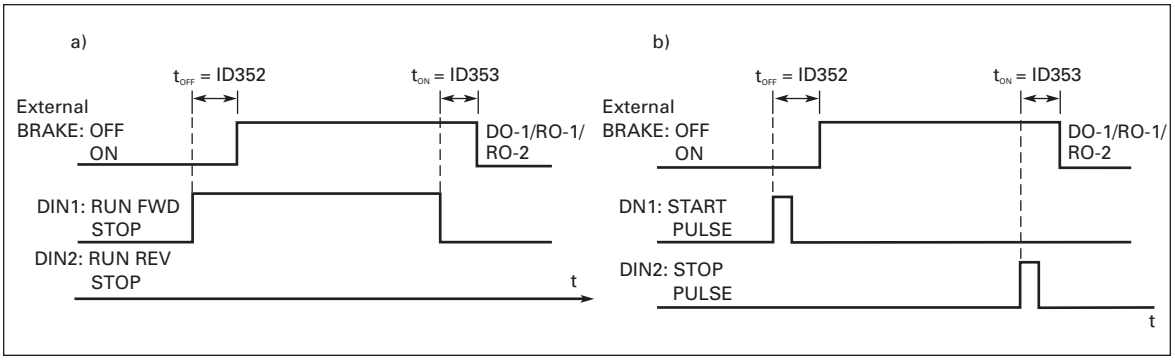


Figure 11-17: External Brake Control

a) Start/Stop Logic Selection, ID300 = 0, 1 or 2
b) Start/Stop Logic Selection, ID300 = 3

354 Frequency converter temperature limit supervision

0	No supervision
1	Low limit supervision
2	High limit supervision

If the temperature of the drive falls below or exceeds the set limit (ID355), this function generates a warning message via digital output DO-1 or relay outputs RO-1 or RO-2 depending on the settings of ID312 to ID314.

355 Frequency converter temperature limit value

This temperature value is supervised by ID354.

359 PID controller minimum limit

360 PID controller maximum limit

With these parameters, you can set the minimum and maximum limits for the PID controller output.

Limit setting: -1000.0% (of f_{Max}) < ID359 < ID360 < 1000.0% (of f_{Max}).

These limits are of importance for example when you define the gain, I-time and D-time for the PID controller.

367 Motor potentiometer memory reset (Frequency reference)

0	No reset
1	Memory reset in stop and power down
2	Memory reset in power down

370 Motor potentiometer memory reset (PID reference)

0	No reset
1	Memory reset in stop and power down
2	Memory reset in power down

500 Acceleration/Deceleration ramp 1 shape

501 Acceleration/Deceleration ramp 2 shape

The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting a value of **0.0** gives a linear ramp shape which causes acceleration and deceleration to react immediately to the changes in the reference signal.

Setting a value from 0.1 – 10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with ID103 and ID104 (ID502 and ID503).

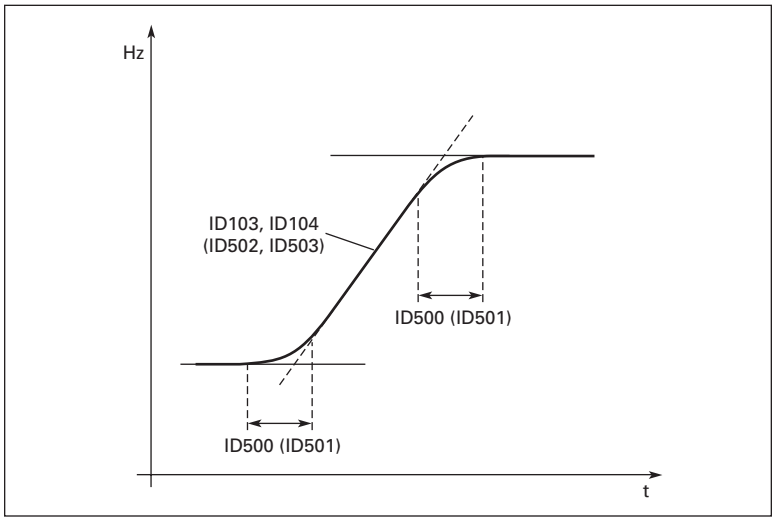


Figure 11-18: Acceleration/Deceleration (S-shaped)

502 Acceleration time 2

503 Deceleration time 2

These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (ID102). These parameters provide the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable signal DIN3 (ID301).

504 Brake chopper

0 No brake chopper used

1 Brake chopper in use and tested when running. Can be tested also in READY state

2 External brake chopper (no testing)

3 Used and tested in READY state and when running

4 Used when running (no testing)

When the drive is decelerating the motor, the energy stored in the inertia of the motor and the load is fed into an external brake resistor. This enables the drive to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). See the separate brake resistor installation manual.

505 Start Function

Ramp:

0 The drive starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times.)

Flying start:

1 The drive is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters.

Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to ride through short utility voltage interruptions.

506 Stop Function

Coasting:

0 The motor coasts to a halt without any control from the drive, after the Stop command.

Ramp:

1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

507 DC-braking current

Defines the current injected into the motor during DC-braking.

508 DC-braking time at stop

Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, ID506.

0.0 DC-brake is not used

>0.0 DC-brake is in use and its function depends on the Stop function, (ID506). The DC-braking time is determined with this parameter.

Par. ID506 = 0; Stop function = Coasting:

After the stop command, the motor coasts to a stop without control of the drive.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is ≥ the nominal frequency of the motor, the set value of parameter ID508 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of parameter ID508.

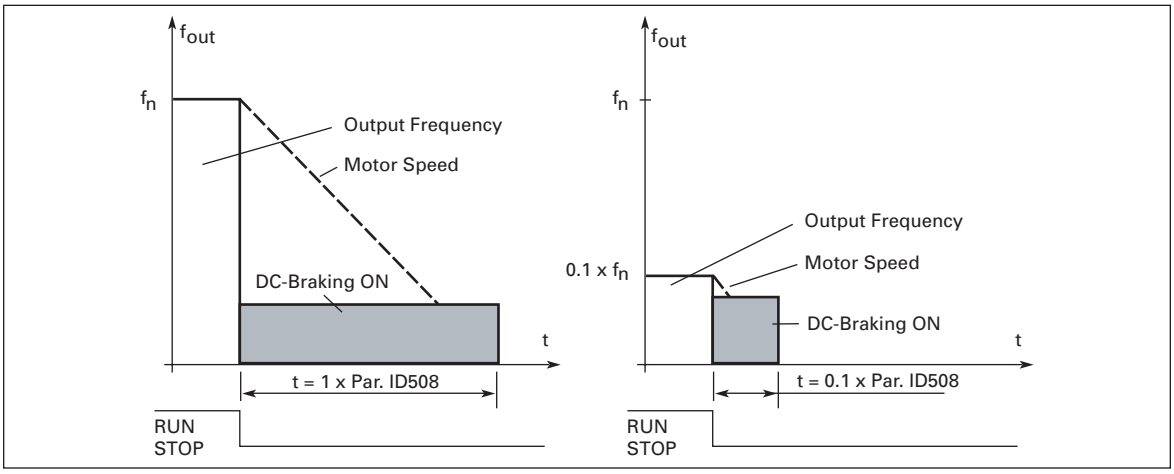


Figure 11-19: DC-Braking Time when Stop Mode = Coasting

Par. ID506 = 1; Stop function = Ramp:

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to the speed defined with parameter ID515, where the DC-braking starts.

The braking time is defined with parameter ID508. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See **Figure 11-20**.

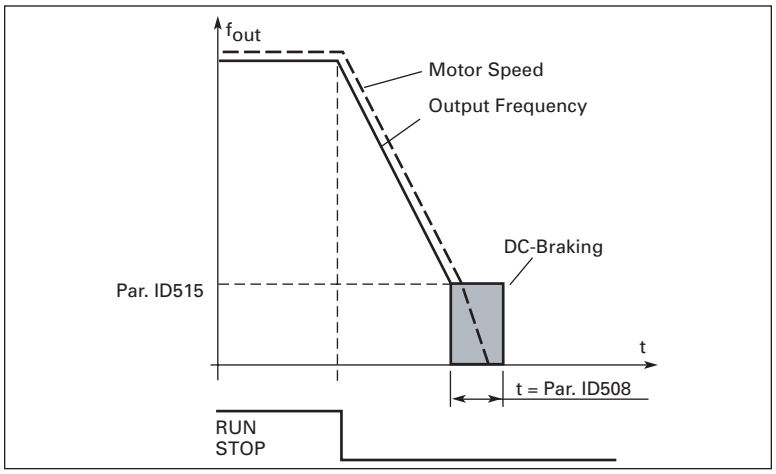


Figure 11-20: DC-Braking Time when Stop Mode = Ramp

509 Skip frequency area 1; Low limit

510 Skip frequency area 1; High limit

511 Skip frequency area 2; Low limit

512 Skip frequency area 2; High limit

513 Skip frequency area 3; Low limit

514 Skip frequency area 3; High limit

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters limits are set for the “skip frequency” regions. See **Figure 11-21**.

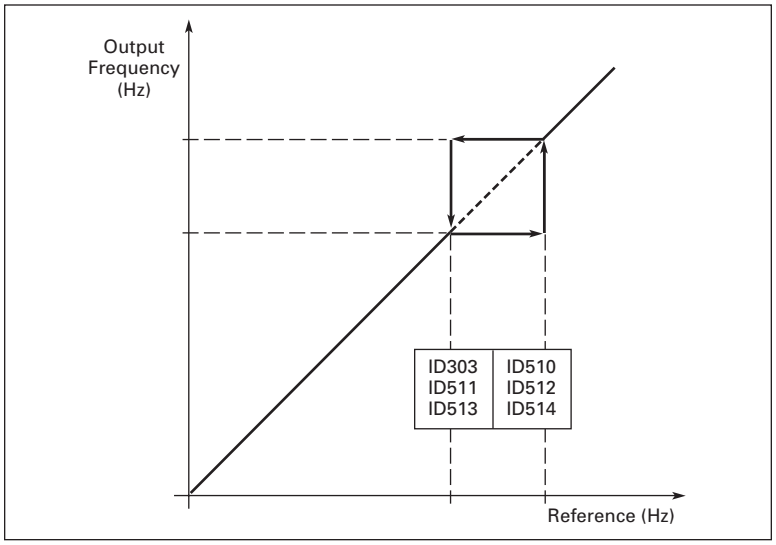


Figure 11-21: Example of Skip Frequency Area Setting

515 DC-braking frequency at stop

The output frequency at which the DC-braking is applied. See **Figure 11-20**.

516 DC-braking time at start

DC-brake is activated when the start command is given. This parameter defines the time before the brake is released. After the brake is released, the output frequency increases according to the set start function by parameter ID505.

518 Acceleration/deceleration ramp speed scaling ratio between skip frequency limits

Defines the acceleration/deceleration time when the output frequency is between the selected skip frequency range limits (ID509 and ID510). The ramping speed (selected acceleration/deceleration time 1 or 2) is multiplied with this factor. E.g. value 0.1 makes the acceleration time 10 times shorter than outside the skip frequency range limits.

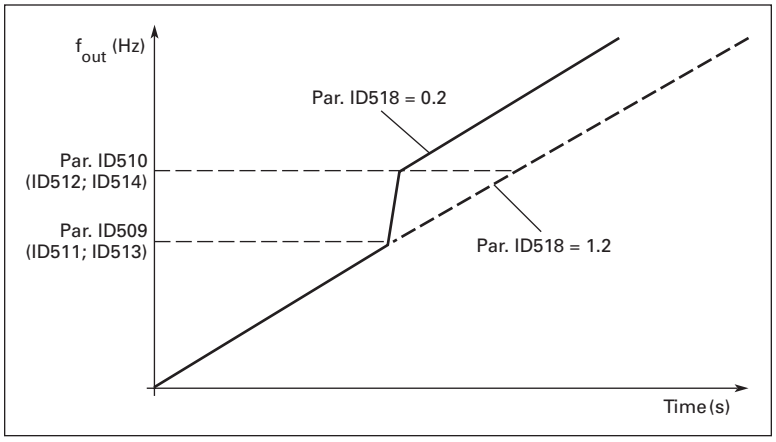


Figure 11-22: Ramp Speed Scaling between Skip Frequencies

519 Flux braking current

Defines the flux braking current value. This value can be set between 0.4*I_H and the Current limit.

520 Flux brake

Instead of DC braking, flux braking is a useful form of braking for motors ≤ 20 hp. When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

0 Flux braking OFF

1 Flux braking ON

Note: Flux braking converts the energy into heat in the motor, and should be used intermittently to avoid motor damage.

600 Motor control mode

0 Frequency control: The I/O terminal and keypad references are frequency references and the drive controls the output frequency (output frequency resolution = 0.01 Hz)

1 Speed control: The I/O terminal and keypad references are speed references and the drive controls the motor speed compensating for motor slip (accuracy ± 0.5%).

601 Switching frequency

Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the rating of the drive. The range of switching frequencies is dependent upon the horsepower size of the drive:

Table 11-4: Size-Dependent Switching Frequencies

Type	Min. [kHz]	Max. [kHz]	Default [kHz]
230V: 1 – 20 hp 480V: 1-1/2 – 40 hp	1.0	16.0	10.0
230V: 25 – 40 hp 480V: 50 – 250 hp	1.0	10.0	3.6

602 Field weakening point

The field weakening point is the output frequency at which the output voltage reaches the set (ID603) maximum value.

603 Voltage at field weakening point

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the V/Hz curve parameters. See ID109, ID108, ID604 and ID605.

When ID110 and ID111 (nominal voltage and nominal frequency of the motor) are set, ID602 and ID603 are automatically set to the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting ID110 and ID111.

604 V/Hz curve, middle point frequency

If the programmable V/Hz curve has been selected with ID108 this parameter defines the middle point frequency of the curve. See **Figure 11-2**.

605 V/Hz curve, middle point voltage

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the middle point voltage of the curve. See **Figure 11-2**.

606 Output voltage at zero frequency

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the zero frequency voltage of the curve. See **Figure 11-2**.

607 Overvoltage controller

This parameter (and ID608) allows the overvoltage (undervoltage) controller to be switched out of operation. This may be useful, for example, if the utility supply voltage varies more than -15% to +10% and the application will not tolerate the overvoltage (undervoltage). When on, this controller adjusts the output frequency based on the supply voltage fluctuations.

Note: An overvoltage trip may occur if the controller is switched off.

0 Controller switched off

1 Controller switched on (no ramping) = Minor adjustments of OP frequency are made

2 Controller switched on (with ramping) = Controller adjusts OP freq. up to max. freq.

608 Undervoltage controller

See ID607.

Note: An undervoltage trip may occur if the controller is switched off.

0 Controller switched off

1 Controller switched on

620 CL: Load drooping

The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor.

631 Identification

700 Response to the 4 mA reference fault

0 No response
1 Warning
2 Warning, the frequency from 10 seconds back is set as reference
3 Warning, the Preset Frequency (ID728) is set as reference
4 Fault, stop mode after fault according to ID506
5 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated if the 4 – 20 mA reference signal is used and the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into digital output DO-1 or relay outputs RO-1 and RO-2.

701 Response to external fault

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated from the external fault signal applied to programmable digital input DIN3. The information can also be programmed into digital output DO-1 or relay outputs RO-1 and RO-2.

702 Output phase supervision

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Output phase supervision of the motor ensures that the motor phases have approximately equal currents.

703 Earth fault protection

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Earth (ground) fault protection ensures that the sum of the motor phase currents is zero. Regardless of the setting of this parameter, the overcurrent protection always functions and protects the drive from earth (ground) faults with high currents.

704 Motor thermal protection

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If a trip is selected the drive will stop and activate the fault stage. Deactivating this protection, i.e. setting parameter to **0**, will reset the thermal stage of the motor to 0%. See **Page 11-47**.

705 Motor thermal protection: Motor ambient temp. factor

The factor can be set between -100.0% – 100.0%. See **Page 11-47**.

706 Motor thermal protection: Motor cooling factor at zero speed

The current can be set between 0 – 150.0% x I_{nMotor}. This parameter sets the value for thermal current at zero frequency. See **Figure 11-23**.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

Note: The value is set as a percentage of the motor nameplate data, ID113 (nominal current of the motor), not the drive's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated.

If you change the parameter Nominal current of motor, this parameter is automatically restored to the default value.

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter ID107 alone. See **Page 11-47**.

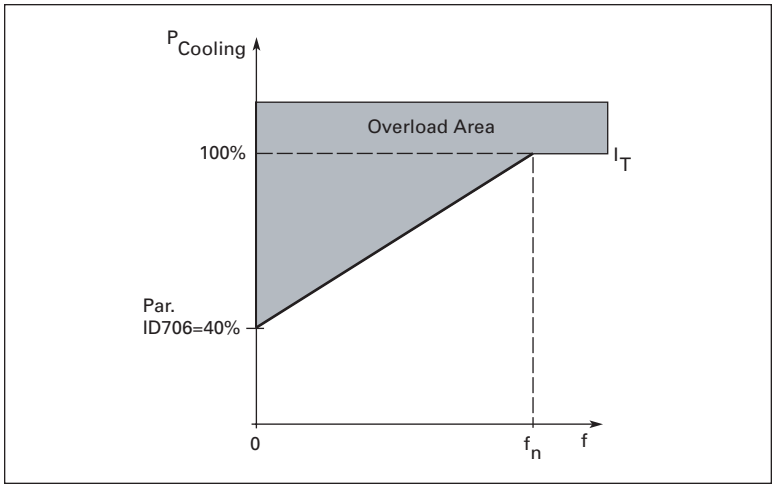


Figure 11-23: Motor Thermal Current I_T Curve

707 Motor thermal protection: Time constant

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor, the larger the motor, the longer the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

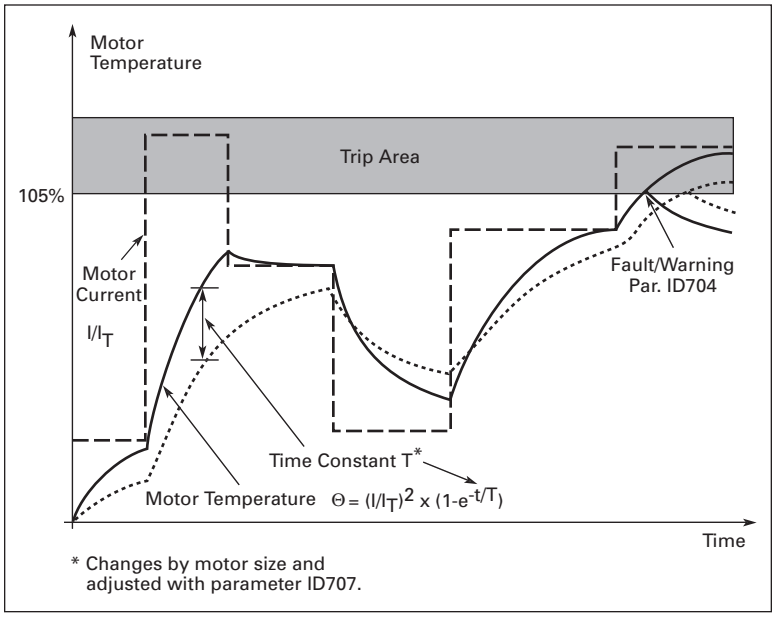


Figure 11-24: Motor Thermal Protection

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor's t6 – time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (from the motor manufacturer) the time constant parameter can be set based on it. As a rule of thumb, the motor thermal time constant in minutes is equal to 2xt6. If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection only so the time constant is increased. See **Figure 11-24**.

708 Motor thermal protection: Motor duty cycle

Defines how much of the nominal motor load is applied.
The value can be set to 0% – 100%. See **Page 11-47**.

709 Stall protection

0	No response
1	Warning
2	Fault, stop mode after fault according to ID506
3	Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection and reset the stall time counter. See **Page 11-47**.

710 Stall current limit

The current can be set to 0.1 – I_{nMotor}*2. For a stall stage to occur, the current must have exceeded this limit. See **Figure 11-25**. If ID113, nominal motor current is changed, this parameter is automatically restored to the default value (I_L). See **Page 11-47**.

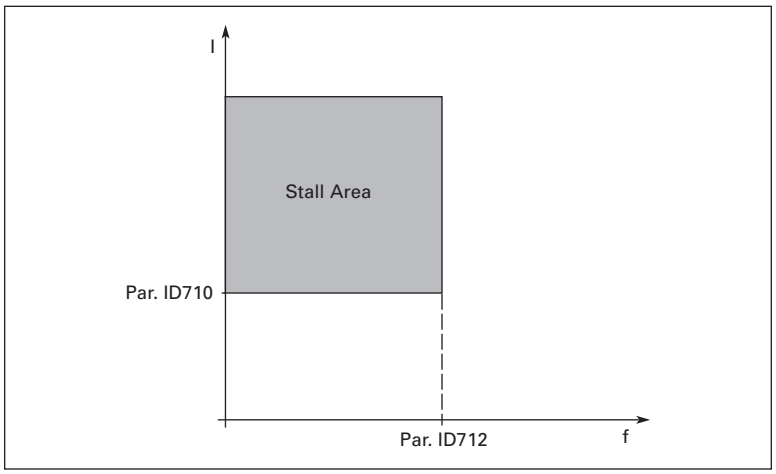


Figure 11-25: Stall Characteristics Settings

711 Stall time

This time can be set between 1.0 and 120.0s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit the protection will cause a trip (see ID709). See **Page 11-47**.

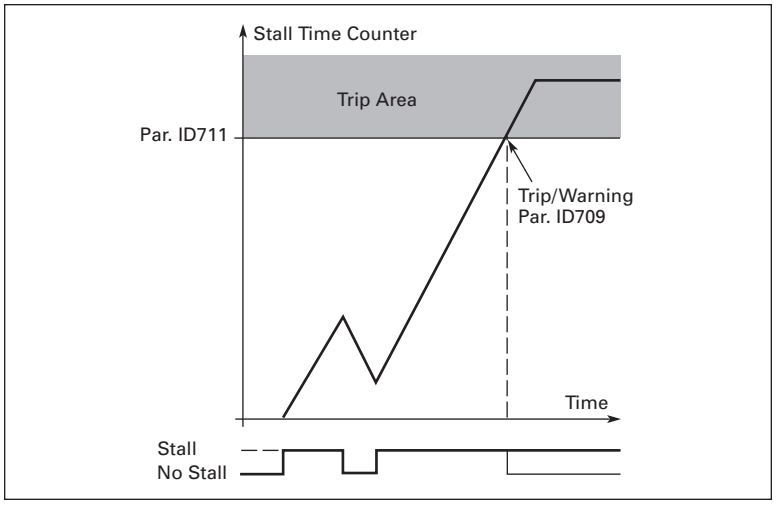


Figure 11-26: Stall Time Count

712 Stall frequency limit

The frequency can be set between 1 – f_{mAx} (ID102).

For a stall state to occur, the output frequency must have remained below this limit. See **Page 11-47**.

713 Underload protection

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If tripping is set active the drive will stop and activate the fault stage. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero. See **Page 11-48**.

714 Underload protection, field weakening area load

The torque limit can be set between 10.0 – 150.0 % x T_{nMotor}.

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See **Figure 11-27**.

If you change ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page 11-48**.

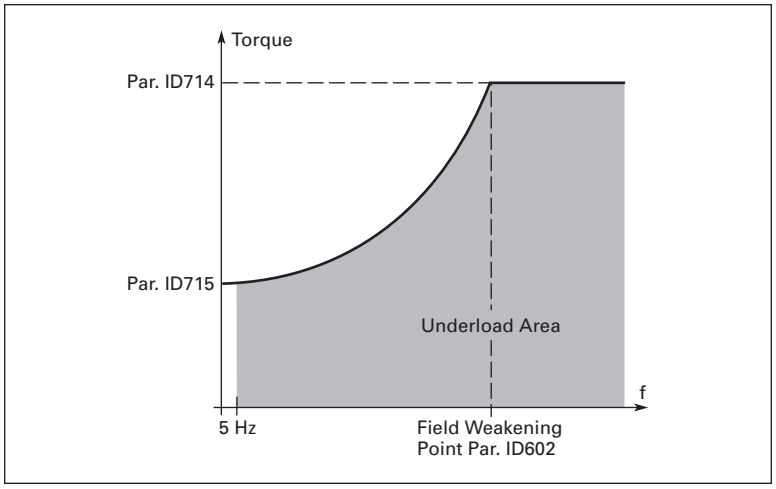


Figure 11-27: Setting of Minimum Load

715 Underload protection, zero frequency load

The torque limit can be set between 5.0 – 150.0 % x T_{nMotor}.

This parameter gives value for the minimum torque allowed with zero frequency. See **Figure 11-27**.

If you change the value of ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page 11-48**.

716 Underload time

This time can be set between 2.0 and 600.0s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to ID713. If the drive is stopped the underload counter is reset to zero. See **Figure 11-28** and **Page 11-48**.

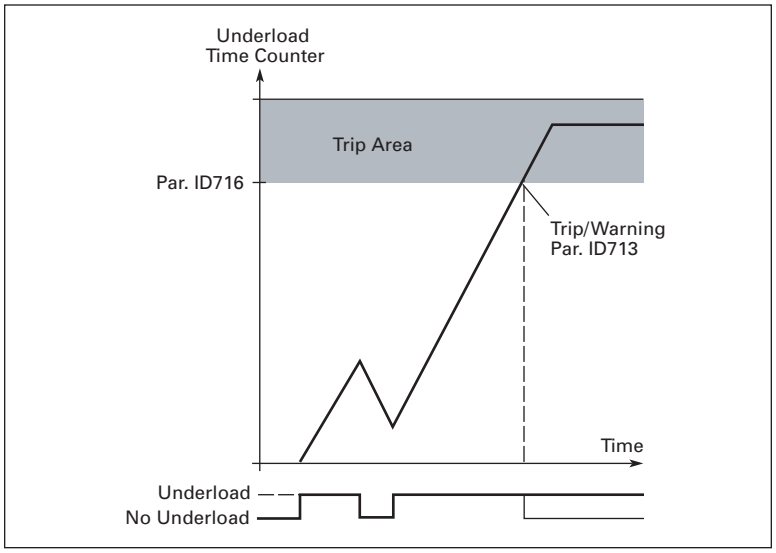


Figure 11-28: Underload Time Counter Function

717 Automatic restart: Wait time

ID717 defines the elapsed time before the drive tries to automatically restart, after the fault has cleared.

718 Automatic restart: Trial time

The Automatic restart function restarts the drive when the faults selected with ID720 to ID725 have cleared and the waiting time has elapsed.

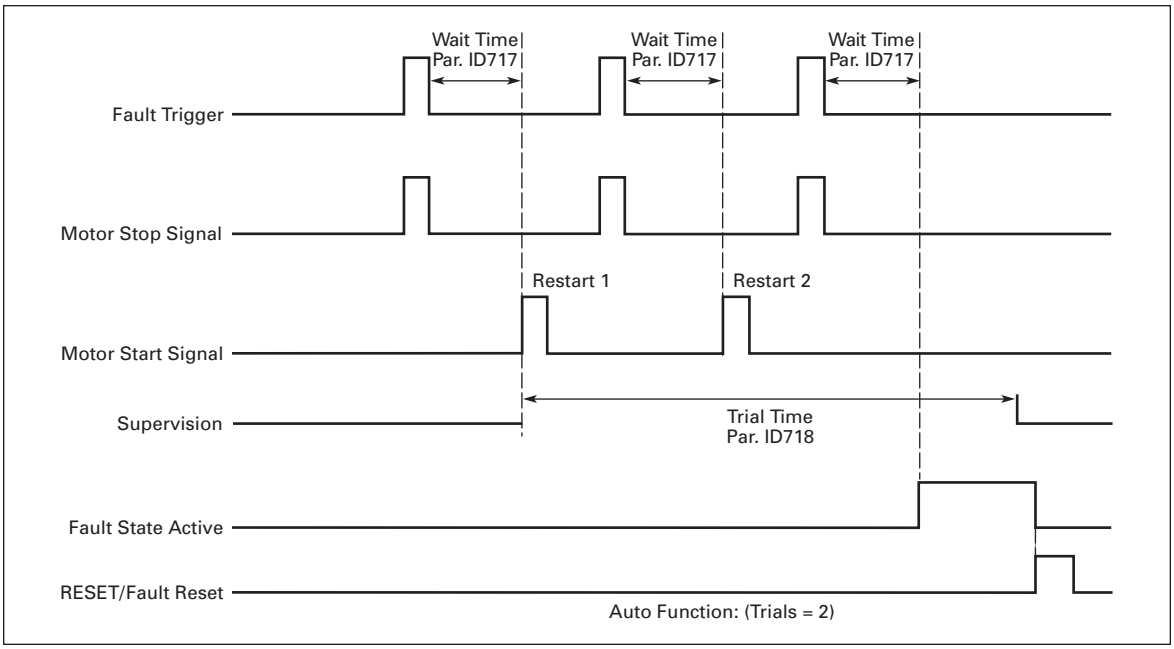


Figure 11-29: Example of Automatic Restarts with Two Restarts

Parameters ID720 to ID725 determine the maximum number of automatic restarts during the trial time set by parameter ID718. The time count starts from the first autorestart. If the number of faults occurring during the trial time exceeds the values of parameters ID720 to ID725 the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again.

If a single fault remains during the trial time, a fault state is true.

719 Automatic restart: Start function

The Start function for Automatic restart is selected with this parameter. The parameter defines the start mode:

0 Start with ramp
1 Flying start
2 Start according to ID505

720 Automatic restart: Number of tries after undervoltage fault trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after an undervoltage trip.

0 No automatic restart

>0 Number of automatic restarts after undervoltage fault. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

721 Automatic restart: Number of tries after overvoltage trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after an overvoltage trip.

0 No automatic restart after overvoltage fault trip

>0 Number of automatic restarts after overvoltage fault trip. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

722 Automatic restart: Number of tries after overcurrent trip

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

Note: An IGBT temperature fault also included as part of this fault.

0 No automatic restart after overcurrent fault trip

>0 Number of automatic restarts after an overcurrent trip, saturation trip or IGBT temperature fault.

723 Automatic restart: Number of tries after reference trip

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after reference fault trip

>0 Number of automatic restarts after the analog current signal (4 – 20 mA) has returned to the normal level (≥ 4 mA)

725 Automatic restart: Number of tries after external fault trip

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after External fault trip

>0 Number of automatic restarts after External fault trip

726 Automatic restart: Number of tries after motor temperature fault trip

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after Motor temperature fault trip

>0 Number of automatic restarts after the motor temperature has returned to its normal level

727 Undervoltage fault mode

0 Fault stored to Fault History

1 Fault not stored to Fault History

728 4 mA reference fault: preset frequency reference

If the value of parameter ID700 is set to 3 and the 4 mA fault occurs then the frequency reference to the motor is the value of this parameter.

730 Input phase supervision

0 No response

1 Warning

2 Fault, stop mode after fault according to ID506

3 Fault, stop mode after fault always by coasting

The input phase supervision ensures that the input phases of the drive have approximately equal currents.

732 Response to thermistor fault

0 No response

1 Warning

2 Fault, stop mode after fault according to ID506

3 Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection.

733 Response to fieldbus fault

This sets the response mode for the fieldbus fault when a fieldbus board is used. For more information, see the respective Fieldbus Board Manual.

See ID732.

734 Response to slot fault

This sets the response mode for a board slot fault caused by a missing or failed board.

See ID732.

738 Automatic restart: Number of tries after underload fault trip

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718.

0 No automatic restart after an Underload fault trip

>0 Number of automatic restarts after an Underload fault trip

739 Number of PT100 inputs in use

If a PT100 input board is installed in the drive, this sets the number of PT100 inputs in use. See the Option Board User Manual.

Note: If the selected value is greater than the actual number of PT100 inputs being used, the display will read 200ºC. If the input is short-circuited the displayed value is -30ºC.

740 Response to PT100 fault

0 No response

1 Warning

2 Fault, stop mode after fault according to ID506

3 Fault, stop mode after fault always by coasting

741 PT100 warning limit

Set here the limit at which the PT100 warning will be activated.

742 PT100 fault limit

Set here the limit at which the PT100 fault (F56) will be activated.

852 to 859 Fieldbus data out selections 1 to 8

Using these parameters, you can observe any monitored item or parameter from the fieldbus. Enter the ID number of the item you wish to observe for its value. See **Page 11-48**.

Some typical values:

Table 11-5: Typical Monitored Items

Item	Description	Item	Description
1	Output frequency	15	Digital inputs 1,2,3 status
2	Motor speed	16	Digital inputs 4,5,6 status
3	Motor current	17	Digital and relay output status
4	Motor torque	25	Frequency reference
5	Motor power	26	Analog output current
6	Motor voltage	27	AI3
7	DC link voltage	28	AI4
8	Unit temperature	31	AO1 (expander board)
9	Motor temperature	32	AO2 (expander board)
13	AI1	37	Active fault 1
14	AI2	—	—

1001 Number of auxiliary drives

With this parameter the number of auxiliary drives in use will be defined. The functions controlling the auxiliary drives (ID458 to ID462) can be programmed to relay outputs or digital output. By default, one auxiliary drive is in use and it is programmed to relay output RO1 at B.1.

1002 Start frequency, auxiliary drive 1

The frequency of the drive controlled by the frequency converter must exceed the limit defined with these parameters with 1 Hz before the auxiliary drive is started. The 1 Hz overdraft makes a hysteresis to avoid unnecessary starts and stops. See also ID101 and ID102.

1003 Stop frequency, auxiliary drive 1

The frequency of the drive controlled by the frequency converter must fall with 1 Hz below the limit defined with these parameters before the auxiliary drive is stopped. The stop frequency limit also defines the frequency to which the frequency of the drive controlled by the frequency converter is dropped after starting the auxiliary drive.

1004 Start frequency, auxiliary drive 2

1005 Stop frequency, auxiliary drive 2

1006 Start frequency, auxiliary drive 3

1007 Stop frequency, auxiliary drive 3

1008 Start frequency, auxiliary drive 4

1016 Sleep frequency

The drive is automatically stopped if its frequency below the Sleep level defined with this parameter for a time greater than that determined by ID1017. During the Stop state, the PID controller is operating switching the drive back to the Run state when the actual value signal either falls below or exceeds (ID1019) the Wake-up level determined by ID1018. See **Figure 11-30**.

1017 Sleep delay

The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped. See **Figure 11-30**.

1018 Wake-up level

The wake-up level defines the level below which the actual value must fall or which has to be exceeded before the Run state of the drive is restored. See **Figure 11-30**.

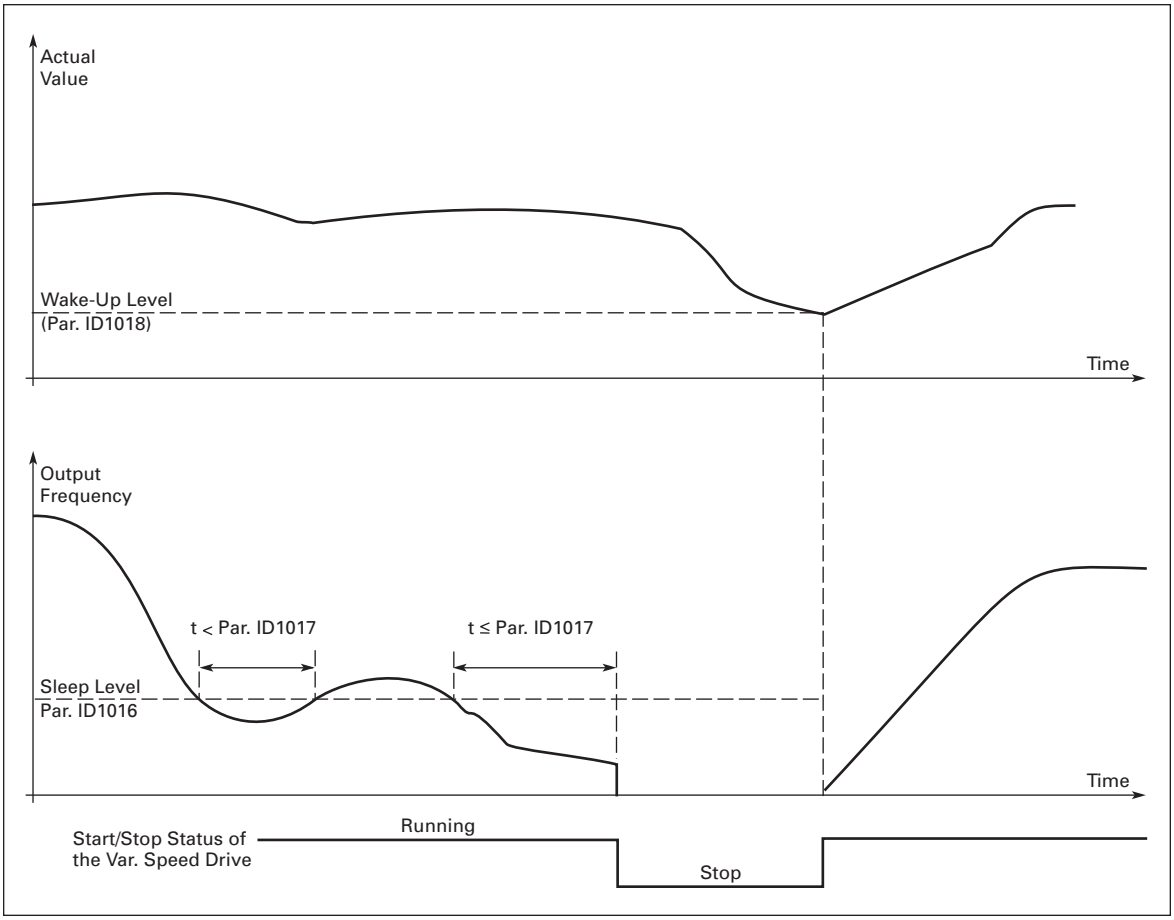
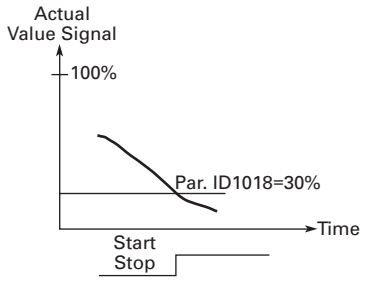
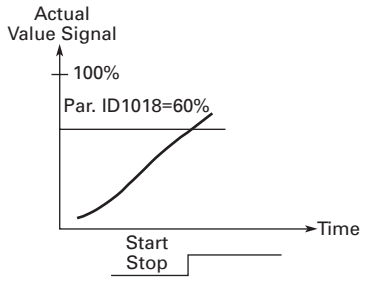


Figure 11-30: Frequency Converter Sleep Function

1019 Wake-up function

This parameter defines whether the restoration of the Run state occurs when the actual value signal falls below or exceeds the Wake-up level (ID1018). See **Figure 11-30**.

Table 11-6: Selectable Wake-Up Functions

Parameter Value	Function	Limit	Description
0	Wake-up happens when actual value goes below the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	
1	Wake-up happens when actual value exceeds the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	

1500 PM Setback Percentage

This parameter determines the frequency reference for PM setback operation when DIN2, DIN4, DIN5 or DIN6 are set to control PM Setback and closed.

1501 DIN1 Function

This parameter determines the function of digital input DIN1.

0 Start – standard start

1 Interlocked Start – To use this, a relay output, RO-1 or RO-2, needs to be programmed for selections 27 "StrtDelayRly," and a digital input DIN2 to DIN6 must be programmed for selection 20 "Interlock." The relay output is used to energize an element of the driven system, such as a damper, seal water solenoid, or a pre-lube pump. Upon a return acknowledgement contact closure to the programmed digital input, the drive will start.

2 Interlock Time Start – This functions the same as the Interlocked Start, except that if the return acknowledgement contact is not received within the ***Interlock Timeout***, an "IntlkTimeExpired RestartDrive" message is displayed and the start sequence will need to be restarted.

3 Delay Start – This start is similar to the Interlocked Start, except that a return contact is not used. After the "Delay Time" following the relay output closure, the Drive starts.

1502 Interlock Timeout

The timeout time used for an Interlocked Time Start, after which the start sequence must be restarted if no acknowledgement contact is received. See ***DIN1 Function***.

1503 Delay Time

The delay time following a Delay Start, after which the drive will be started. See ***DIN1 Function***.

1504 DIN4 Function

This parameter has 20 selections. If digital input DIN4 is not used, set this value to **0**.

0	Not Used
1	External fault closed
2	Bypass Ovld Fault
3	Run enable/External interlock – Contact open: Drive start disabled Contact closed: Drive start enabled
4	Acceleration or deceleration time selection – Contact open: Acceleration/Deceleration time 1 selected Contact closed: Acceleration/Deceleration time 2 selected
5	Hand/Auto Select – contact closed: Auto control selected
6	PID Control – contact closed: PID control selected
7	Motor potentiometer down – contact closed: Motor potentiometer down selected
8	PID Reference 2 Select – selects between ***PID Reference*** and PID Setpoint 2 from keypad
9	PM Setback – contact closed: PM Setback enabled
10	Fault reset – contact closed: All faults reset
11	Acceleration/Deceleration prohibited – Contact closed: No acceleration or deceleration possible until the contact is opened
12	HOA On/Off – contact closed: HOA Off
13	Reserved
14	Fire Mode – contact closed: Fire Mode selected.
15	Fire Mode Reference Select – Contact open or closed based on ***FMRefSelFunction***. If this input is "ON", then ***FireModeFreqRef1*** or ***FireModeFreqRef2*** is selected as a "Preset Speed."
16	PID control active
17	Preset speed 1 selected P1.10.1
18	Preset speed 2 selected P1.10.2
19	Force Bypass
20	Interlock – See parameter P1.2.1 for details

1505 DIN6 Function

This parameter has 20 selections. If digital input DIN6 is not used, set this value to **0**.

0	Overload relay. When bypass is installed DIN6 Function is automatically (permanently) defaulted = 0 and selection of other function is disabled.
1	External fault closed
2	Bypass Ovld Fault
3	Run enable/External interlock – Contact open: Drive start disabled Contact closed: Drive start enabled
4	Acceleration or deceleration time selection – Contact open: Acceleration/Deceleration time 1 selected Contact closed: Acceleration/Deceleration time 2 selected
5	Hand/Auto Select – contact closed: Auto control selected
6	PID Control – contact closed: PID control selected
7	Motor potentiometer down – contact closed: Motor potentiometer down selected
8	PID Reference 2 Select – selects between ***PID Reference*** and PID Setpoint 2 from keypad
9	PM Setback – contact closed: PM Setback enabled
10	Fault reset – contact closed: All faults reset
11	Acceleration/Deceleration prohibited – Contact closed: No acceleration or deceleration possible until the contact is opened
12	HOA On/Off – contact closed: HOA Off
13	Reserved
14	Fire Mode – contact closed: Fire Mode selected.
15	Fire Mode Reference Select – Contact open or closed based on ***FMRefSelFunction***. If this input is "ON", then ***FireModeFreqRef1*** or ***FireModeFreqRef2*** is selected as a "Preset Speed."
16	PID control active
17	Preset speed 1 selected P1.10.1
18	Preset speed 2 selected P1.10.2
19	Force Bypass
20	Interlock – See parameter P1.2.1 for details

1506 Slot D, RO-1

See ID 312.

1507 Slot D, RO-2

See ID 312.

1508 Slot D, RO-3

See ID 312.

1509 Fire Mode Function

Fire Mode is used to start motor and continue to operate due to emergency conditions. Faults will be changed to warnings to prevent shutdown. The overload should be selected to AUTO to prevent overload trip during "Fire Mode" operation. This is only required if unit is a Bypass, which uses an electronic overload with contactor to run motor. If set to AUTO on the overload, the overload fault will be ignored and motor will continue to run.

⚠ IMPORTANT

The electronic overload on the contactor must be set to AUTO, otherwise the overload will function normally.

Note: (1) When activated while running in Bypass electronic overload is also ignored.
(2) Only pressing the STOP button on the drive keypad or removing the "Fire Mode" digital input will stop the drive operation.

This parameter determines whether the fire mode function is determined by a contact closure or contact opening on digital input.

0 Closing contact initiates fire mode function
1 Opening contact initiates fire mode function

1510 Fire Mode Reference Selection Function

Setting this parameter to 1 causes the maximum frequency to occur with the minimum reference (***Fire Mode Frequency Reference 1*** or ***Fire Mode Frequency Reference 2***) input and the minimum frequency to occur with the maximum reference input.

0 Not inverted
1 Inverted

1511 Fire Mode Minimum Frequency

This parameter sets the minimum output frequency for fire mode.

1512 Fire Mode Frequency Reference 1

This parameter sets the drive operating frequency for fire mode reference 1.

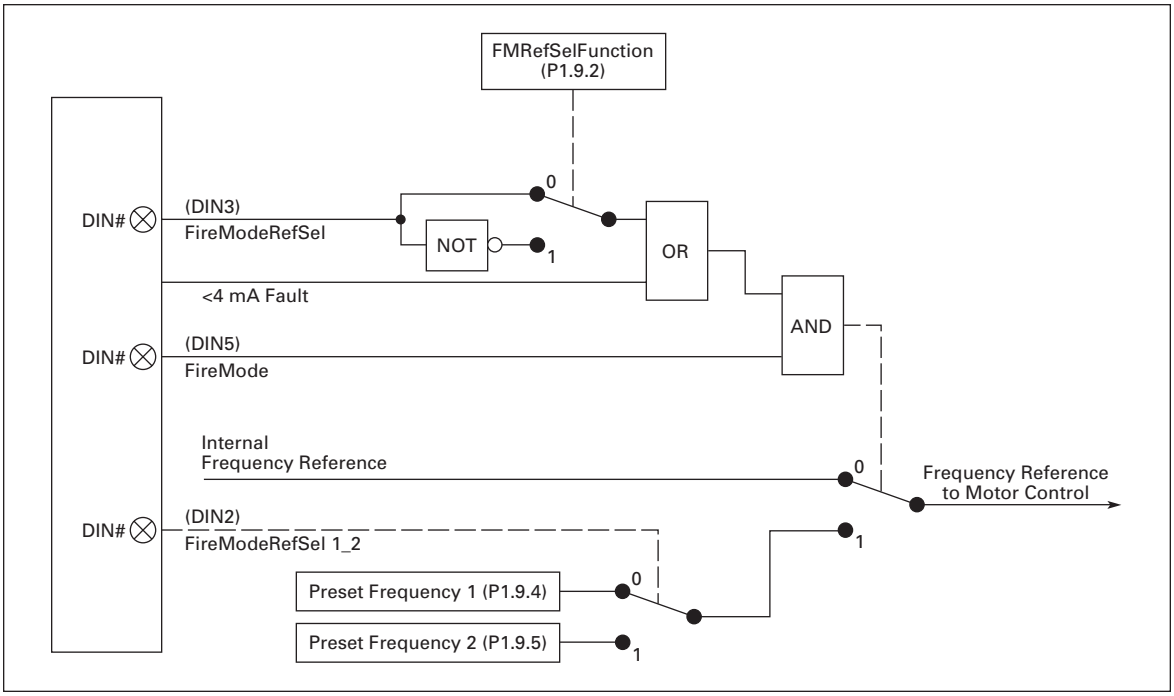


Figure 11-31: Frequency Reference Logic of the Fire Mode PID Application When Running in Fire Mode

1513 Fire Mode Frequency Reference 2

This parameter sets the drive operating frequency for fire mode reference 2.

1514 #1 Preset Speed

This parameter defines the #1 preset speed.

1515 #2 Preset Speed

This parameter defines the #2 preset speed.

1516 #3 Preset Speed

This parameter defines the #3 preset speed.

1517 #4 Preset Speed

This parameter defines the #4 preset speed.

1518 #5 Preset Speed

This parameter defines the #5 preset speed.

1519 #6 Preset Speed

This parameter defines the #6 preset speed.

1521 Sensor Minimum Scale
Feedback sensor minimum output value.

1522 Sensor Maximum Scale
Feedback sensor maximum output value.

1523 PID Control Activation
0 Disabled
1 Enabled

1524 PID Setpoint Min. Limit Default: Same value as ID1521.
PID Setpoint limitation minimum value.

1525 PID Setpoint Max. Limit Default: Same value as ID1522.
PID Setpoint limitation maximum value.

1685 Motor Service Factor
This value is multiplied by the motor nominal current to set the Current Limit.

1837 VCOS Shutdown Default: No
VCOS vibration cutout switch for drive fault.

1838 VCOS Alarm Default: No
VCOS vibration cutout alarm switch.

These two parameters exist in the Start-Up Wizard. When selecting either “no” or “yes”, you force P1.2.6 (Slot A, DIN4) or P1.2.7 (Slot A, DIN5) for either selection 21 “no” Vibration Cutout (closed contact) or selection 22 “yes” Vibration Cutout (open contact). If P1.2.6 or P1.2.7 digital inputs are programmed for anything other than the Vibration Cutout, then these two parameters should not be changed, otherwise they will force the selections for DIN4 or DIN5 to “21” or “22”.

Keypad Control Parameters

Unlike the parameters listed above, these parameters are located in the **M2** menu of the control keypad. The keypad reference parameter does not have an ID number.

114 STOP button activated

To make the STOP button a “hotspot” which always stops the drive regardless of the selected control place, set the value of this parameter to **1**.

123 Keypad direction

0	Forward: The rotation of the motor is forward, when the keypad is the active control place.
1	Reverse: The rotation of the motor is reverse, when the keypad is the active control place.

For more information, see **Chapter 6**, Keypad Control Menu (M2).

R2.1 Keypad reference

The frequency reference can be adjusted from the keypad with this parameter.

The output frequency can be copied as the keypad reference by pressing the STOP button for 3 seconds when you are on any of the pages of menu **M2**. For more information, see **Chapter 6**, Keypad Control Menu (M2).

167 PID Setpoint 1

The PID controller keypad reference can be set between 0% and 100%. This reference value is the active PID reference if ID332 = 2.

168 PID Setpoint 2

Additional Information

In this section you will find additional information on special parameter groups. Such groups are:

- Parameters of Motor Thermal Protection
- Parameters of Stall Protection (see **Page 11-47**)
- Parameters of Underload Protection (see **Page 11-48**)
- Fieldbus Control Parameters (see **Page 11-48**)

Parameters of Motor Thermal Protection

ID704 to ID708

General

The motor thermal protection is to protect the motor from overheating. The drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the integral motor fan is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.

The motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor.

The motor thermal protection can be adjusted with ID704 to ID708. The thermal current I_T specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

The thermal stage of the motor can be monitored on the control keypad display. See **Page 6-20**.

⚠ CAUTION

The calculated model does not protect the motor if the airflow to the motor is reduced by a cooling fan failure or a blocked air intake grill.

Parameters of Stall Protection

ID709 to ID712

General

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, ID710 (Stall current) and ID712 (Stall frequency limit). If the current is higher than the set limit and output frequency is lower than the set limit, the stall state is true. Actual shaft rotation is not determined. Stall protection is a type of overcurrent protection.

Parameters of Underload Protection

ID713 to ID716

General

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load, there might be a problem in the process, e.g. a broken belt or a dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters ID714 (Field weakening area load) and ID715 (Zero frequency load). The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5 Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set as a percentage of the nominal torque of the motor. The motor's nameplate data, the motor nominal current and the drive's nominal current I_H are used to find the scaling ratio for the internal torque value. If other than a standard motor is used, the accuracy of the torque calculation decreases.

Fieldbus Control Parameters

ID850 to ID859

The Fieldbus control parameters are used when the frequency or the speed reference comes from the fieldbus (Modbus, Profibus, DeviceNet, etc.). With the Fieldbus Data Out Selection 1 – 8 you can monitor values from the fieldbus.

August 2006

Appendix A — Technical Data

Specifications

Table A-1: BAC VFD Specifications

Description	Specification
Power Connections	
Input Voltage (V_{in})	230V +10%/-15% 480V +10%/-15% 575V +10%/-15%
Input Frequency (f_{in})	50/60 Hz (variation up to 45 – 66 Hz)
Connection to Utility Power	Once per minute or less (typical operation)
High Interrupt Rating	The current withstand rating of the drive is 100,000 Amperes 208V 36 kAIC 230V 26 kAIC 480V 36 kAIC 575V 5 kAIC
Motor Connections	
Output Voltage	0 to V_{in}
Continuous Output Current	Ambient temperature max. +104°F (+40°C), overload 1.1 x I_L (1 min./10 min.)
Starting Torque	110%
Output Frequency	0 to 320 Hz
Frequency Resolution	0.01 Hz
Control Characteristics	
Control Method	Frequency Control (V/f) Open Loop Sensorless Vector Control
Switching Frequency	Adjustable with ***Switching Frequency*** 230V: 1 – 20 hp: 1 to 16 kHz; default 10 kHz 25 – 75 hp: 1 to 10 kHz; default 3.6 kHz 480V: 1 – 40 hp: 1 to 16 kHz; default 10 kHz 50 – 250 hp: 1 to 10 kHz; default 3.6 kHz 575V: All hp: 1 to 6 kHz; default 1.5 kHz
Frequency Reference	Analog Input: Resolution 0.1% (10-bit), accuracy ±1% Panel Reference: Resolution 0.01 Hz
Field Weakening Point	30 to 320 Hz
Acceleration Time	0.1 to 3000 sec.
Deceleration Time	0.1 to 3000 sec.
Braking Torque	DC brake: 15% to 30% x T_n (without brake option)
Environment	
Ambient Operating Temperature	14°F (-10°C), no frost to 104°F (+40°C)
Storage Temperature	-40°F (-40°C) to 158°F (70°C)
Relative Humidity	0 to 95% RH, non-condensing, non-corrosive, no dripping water
Air Quality	Chemical vapors: IEC 60721-3-3, unit in operation, class 3C2 Mechanical particles: IEC 60721-3-3, unit in operation, class 3S2
Altitude	100% load capacity (no derating) up to 3300 ft. (1000m); 1% derating for each 330 ft. (100m) above 3300 ft. (1000m); max. 10000 ft. (3000m)

Table A-1: BAC VFD Specifications (Continued)

Description	Specification
Environment, continued	
Vibration	EN 50178, EN 60068-2-6 5 to 50 Hz, displacement amplitude 1 mm (peak) at 3 to 15.8 Hz, Max. acceleration amplitude 1 G at 15.8 to 150 Hz
Shock	EN 50178, EN 60068-2-27 UPS Drop test (for applicable UPS weights) Storage and shipping: max. 15 G, 11 ms (in package)
Enclosure Class	TYPE 1/IP21 standard 250 hp and below Open chassis standard 300 hp and above
Standards	
EMC (at default settings)	Immunity: Fulfils all EMC immunity requirements Emissions: EN 61800-3 Level H
Safety	UL 508C/CSA
Product	IEC 61800-2
Control Connections	
Analog Input Voltage	0 to 10V, R - 200Ω differential Resolution 0.1%; accuracy ±1% (can be converted to a current with a jumper)
Analog Input Current	0(4) to 20 mA; R_i – 250Ω differential (can be converted to a voltage with a jumper)
Digital Inputs (6)	Positive or negative logic; 18 to 24V DC
Auxiliary Voltage	+24V ±15%, max. 250 mA
Output Reference Voltage	+10V +3%, max. load 10 mA
Analog Output	0(4) to 20 mA; R_L max. 500Ω; Resolution 10 bit; Accuracy ±2% or 0 to 10V, R_L 1 kΩ, select with jumper
Digital Outputs	Open collector output, 50 mA/48V
Relay Outputs	2 programmable Form C relay outputs Switching capacity: 24V DC / 8A, 250V AC / 8A, 125V DC / 0.4A Minimum switching load: 5V/10 mA Continuous capacity: <2 A_{rms}
Protections	
Overcurrent Protection	Yes — Trip limit 4.0 x I_{vt} instantaneously
Overvoltage/Undervoltage Protection	Yes
Ground (Earth) Fault	In case of a ground fault in motor or motor cables, only the BAC VFD is protected
Input Phase Supervision	Trips if any of the input phases are missing
Motor Phase Supervision	Trips if any of the output phases are missing
Overtemperature Protection	Yes
Motor Overload Protection	Yes
Motor Stall Protection	Yes
Motor Underload Protection	Yes
Short Circuit Protection of the +24V and +10V Reference Voltages	Yes

Power Ratings

Table A-2: 230V VT Output Power Ratings

Catalog Number ①	Frame Size	Three-Phase Input	
		Horsepower (hp)	Current (Amps)
BAC001x2_	FR4	1	4.8
BACF15x2_		1-1/2	6.6
BAC002x2_		2	7.8
BAC003x2_		3	11
BAC005x2_	FR5	5	17.5
BAC007x2_		7-1/2	25
BAC010x2_		10	31
BAC015x2_	FR6	15	48
BAC020x2_		20	61
BAC025x2_	FR7	25	75
BAC030x2_		30	88
BAC040x2_		40	114

① Insert a "1" for TYPE 1 or a "2" for TYPE 12 in place of the "x" in the Catalog Number.

Table A-3: 480V VT Output Power Ratings

Catalog Number ①	Frame Size	Three-Phase Input	
		Horsepower (hp)	Current (Amps)
BACF15x4_	FR4	1-1/2	3.3
BAC002x4_		2	4.3
BAC003x4_		3	5.6
BAC005x4_		4	7.6
BAC007x4_		7-1/2	12
BAC010x4_	FR5	10	16
BAC015x4_		15	23
BAC020x4_		20	31
BAC025x4_	FR6	25	38
BAC030x4_		30	46
BAC040x4_		40	61
BAC050x4_	FR7	50	72
BAC060x4_		60	87
BAC075x4_		75	105
BAC100x4_	FR8	100	140
BAC125x4_		125	170
BAC150x4_		150	205

① Insert a "1" for TYPE 1 or a "2" for TYPE 12 in place of the "x" in the Catalog Number.

Note: Current ratings of assemblies are sometimes less than listed ratings.

Table A-4: 575V VT Output Power Ratings

Catalog Number ①	Frame Size	Three-Phase Input	
		Horsepower (hp)	Current (Amps)
BAC003x5_	FR6	3	4.5
BAC005x5_		5	7.5
BAC007x5_		7-1/2	10
BAC010x5_		10	13.5
BAC015x5_		15	18
BAC020x5_		20	22
BAC025x5_		25	27
BAC030x5_		30	34
BAC040x5_	FR7	40	41
BAC050x5_		50	52
BAC060x5_	FR8	60	62
BAC075x5_		75	80
BAC100x5_		100	100

① Insert a "1" for TYPE 1 or a "2" for TYPE 12 in place of the "x" in the Catalog Number.

Note: Current ratings of assemblies are sometimes less than listed ratings.

Power Loss and Switching Frequency

In some situations it may be desirable to change the switching frequency of the BAC VFD for some reason (typically e.g. to reduce the motor noise). Raising the switching frequency above the factory default level increases the drive power loss and increases the cooling requirements. **Figures A-1** through **A-6** illustrate the power loss increase for the different BAC VFD models. When operating above the default switching frequency, the BAC VFD output current rating should be derated by the ratio of the increased power loss to the nominal power loss.

Example: The user of a 40 hp, 61A, 480V BAC VFD wishes to increase the switching frequency from the factory default value of 10 kHz to 15 kHz to reduce motor noise. From **Figure A-3** the loss at the factory default switching frequency of 10 kHz is 1240 watts. The loss at 15 kHz from **Figure A-3** is 1340 watts.

$$\text{Re } rate = 61 \times \frac{1240}{1340} = 56\text{A}$$

Thus at the increased switching frequency, the maximum load allowed is 56A to avoid overheating the BAC VFD.

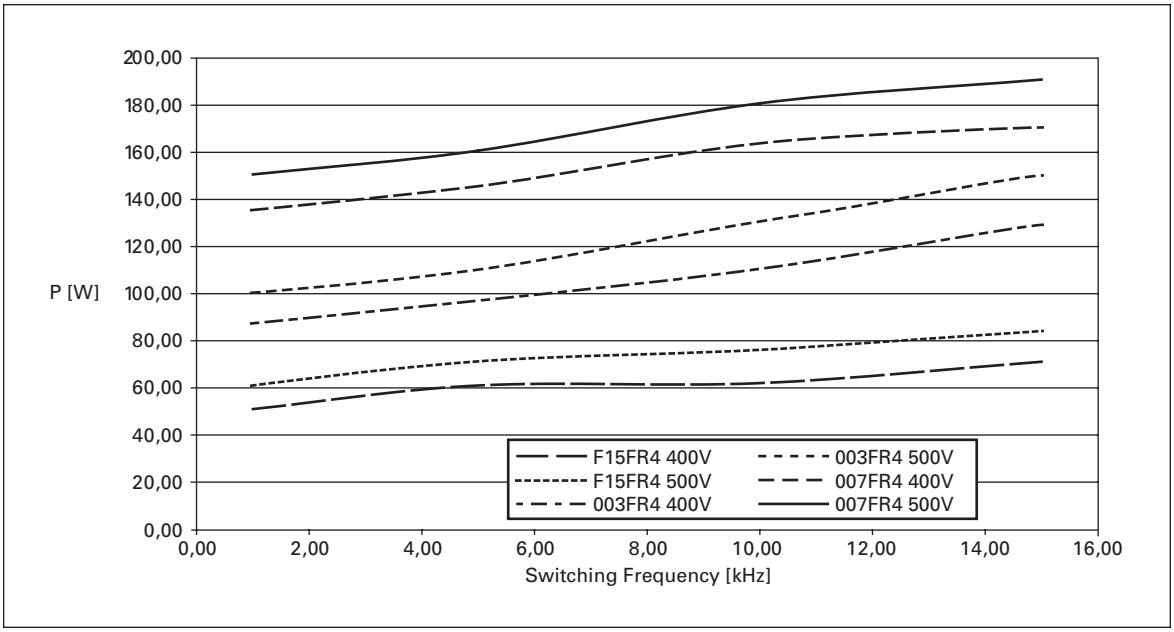


Figure A-1: Power Loss as Function of Switching Frequency: 1 – 3 hp 230V, 1-1/2 – 7-1/2 hp 480V

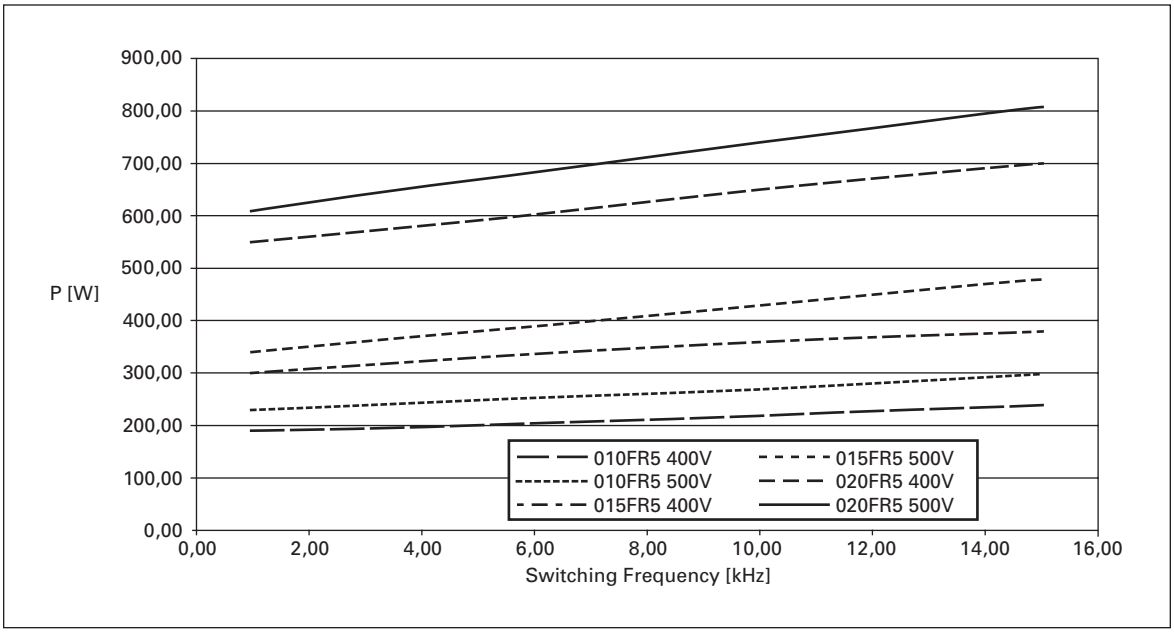


Figure A-2: Power Loss as Function of Switching Frequency: 5 – 10 hp 230V, 10 – 20 hp 480V

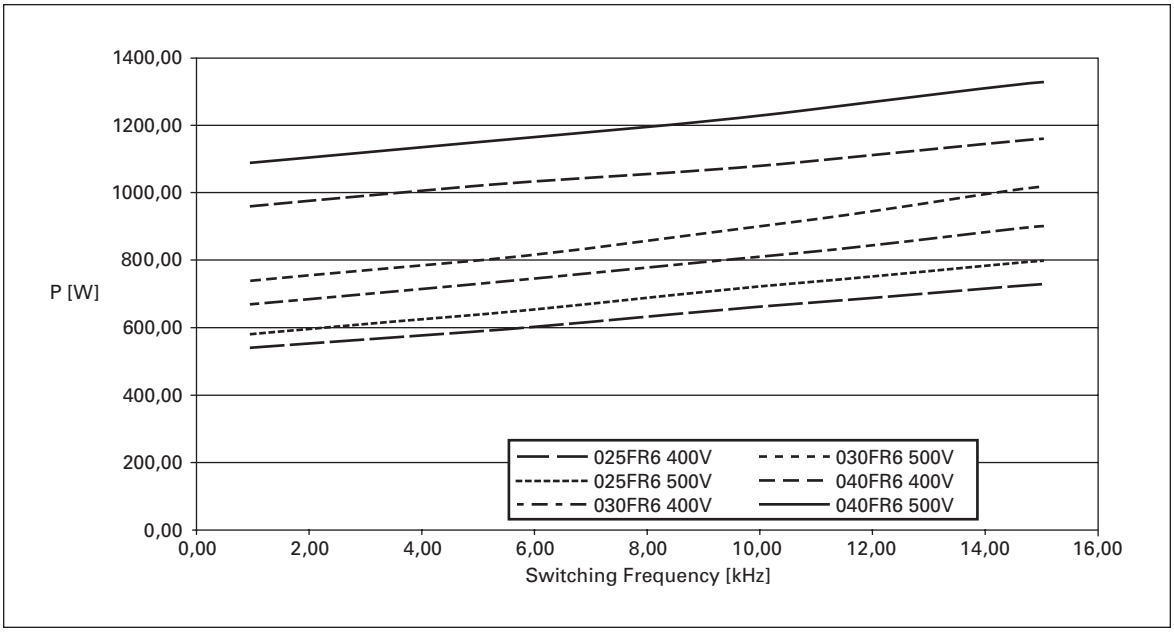


Figure A-3: Power Loss as Function of Switching Frequency: 15 and 20 hp 230V, 25 – 40 hp 480V

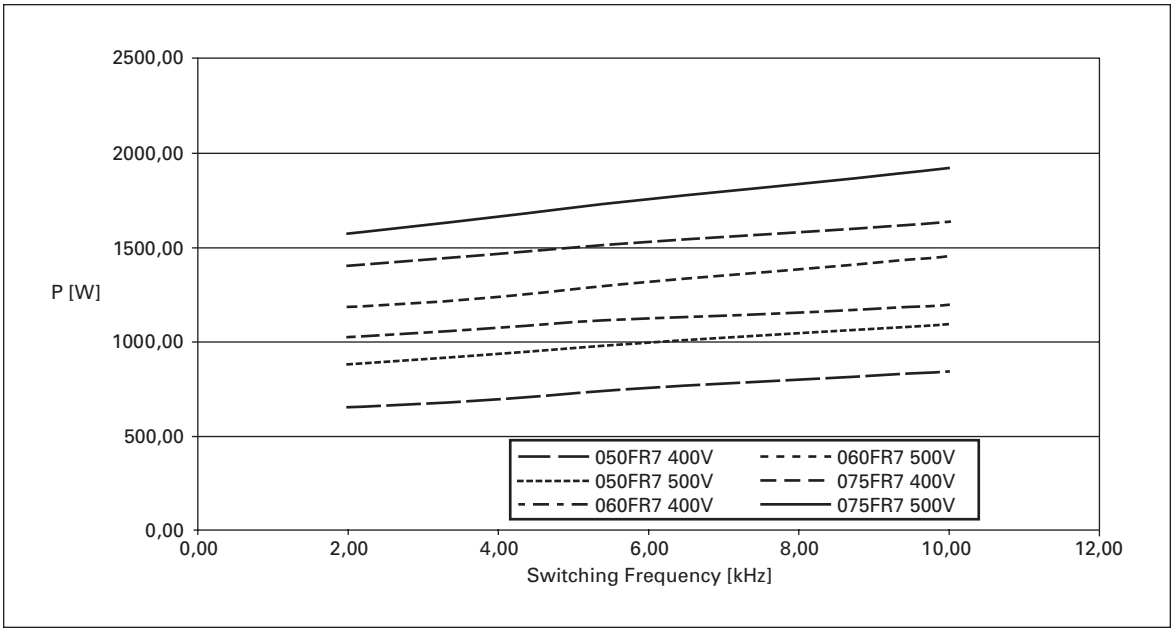


Figure A-4: Power Loss as Function of Switching Frequency: 50 – 75 hp 480V

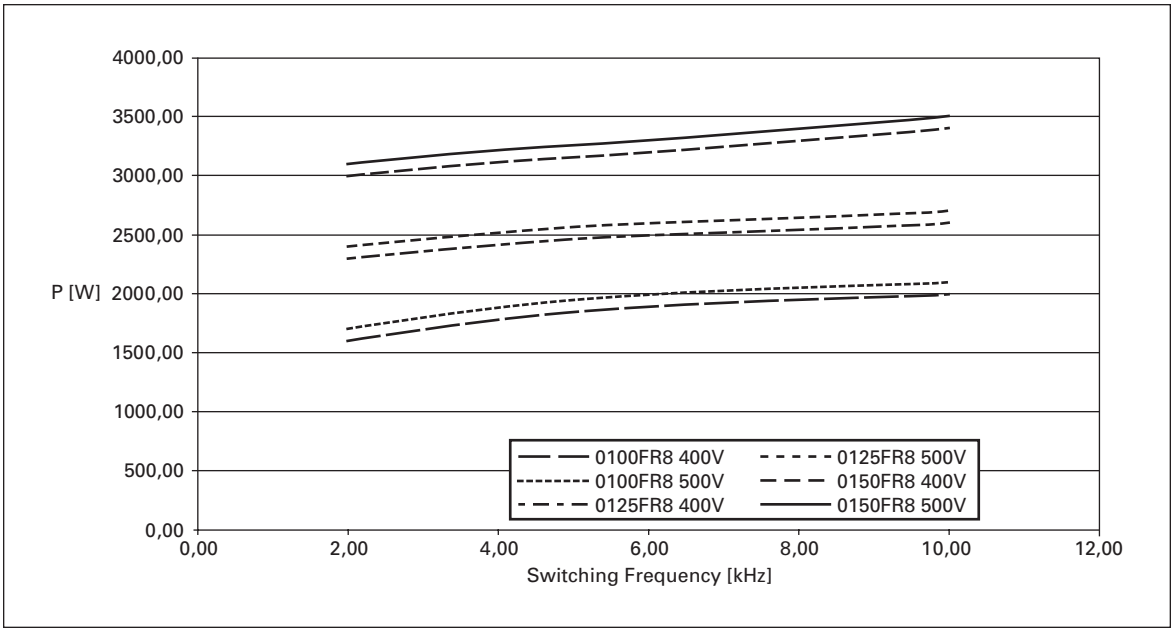


Figure A-5: Power Loss as Function of Switching Frequency: 100 – 150 hp 480V

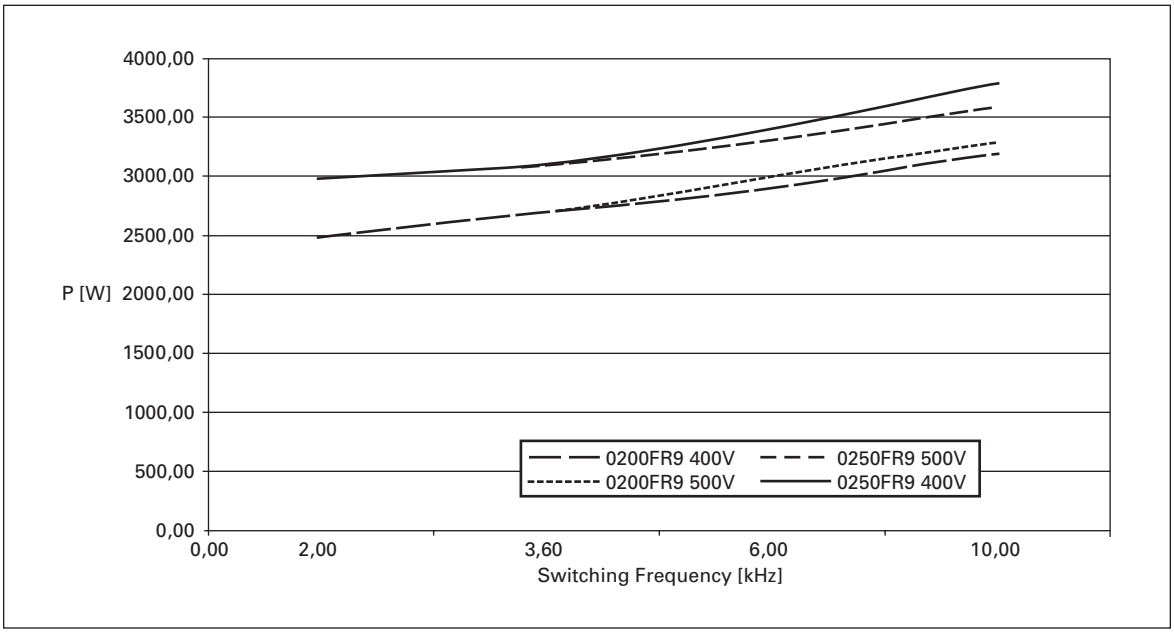


Figure A-6: Power Loss as Function of Switching Frequency: 200 – 250 hp 480V

Dimensions

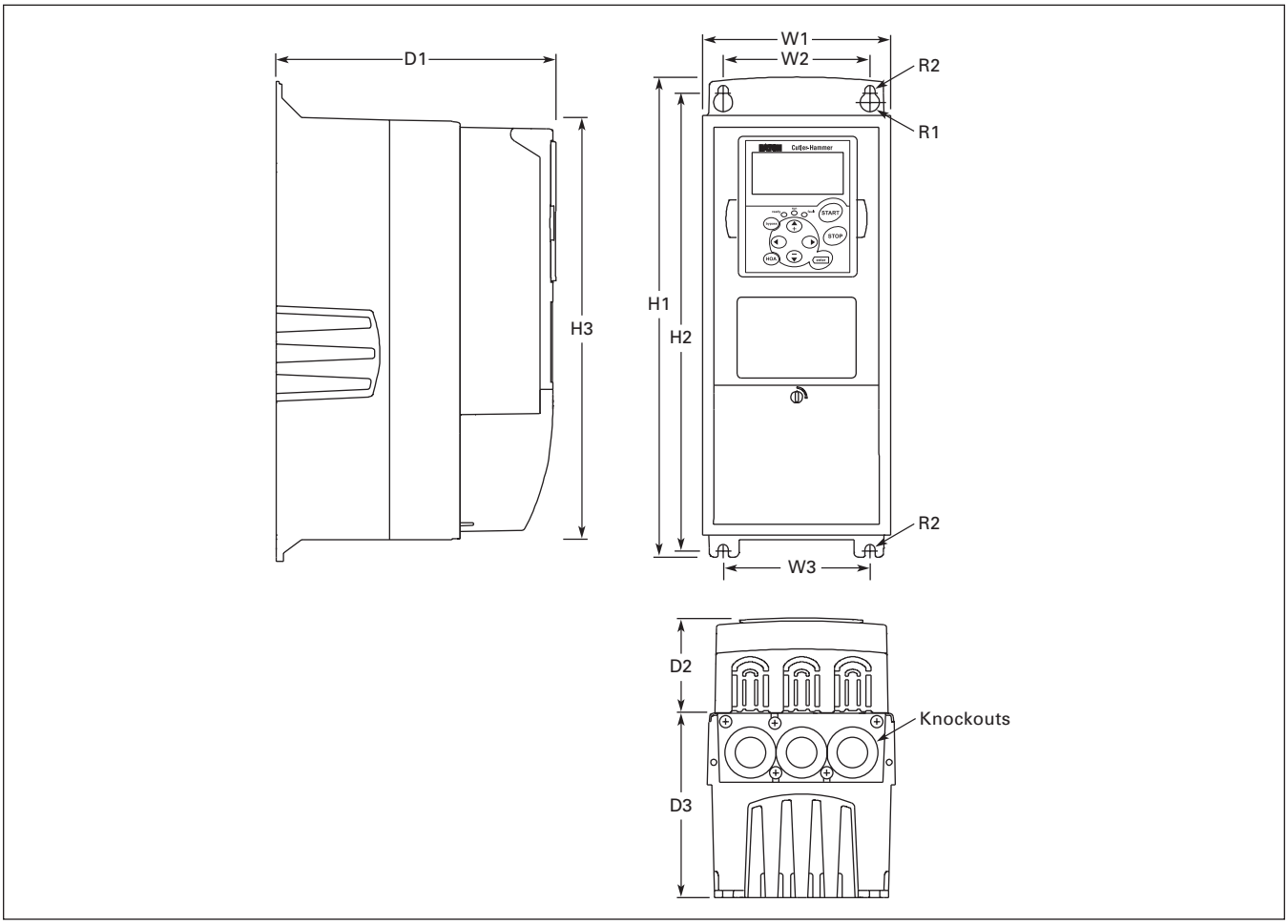


Figure A-7: TYPE 1 and TYPE 12 BAC Open VFD Dimensions, FR4, FR5 and FR6

Table A-5: BAC Open VFD Dimensions

Frame Size	Voltage	hp (VT)	Approximate Dimensions in Inches (mm)											Weight Lbs. (kg)	Knockouts @ Inches (mm)
			H1	H2	H3	D1	D2	D3	W1	W2	W3	R1 dia.	R2 dia.		N1 (O.D.)
FR4	230V	1 – 3	12.9 (327)	12.3 (313)	11.5 (292)	7.5 (190)	2.5 (64)	5.0 (126)	5.0 (128)	3.9 (100)	—	.5 (13)	.3 (7)	11.0 (5)	3 @ 1.1 (28)
	480V	1-1/2 – 7-1/2													
FR5	230V	5 – 10	16.5 (419)	16.0 (406)	15.4 (391)	8.4 (214)	2.7 (68)	5.7 (148)	5.7 (144)	3.9 (100)	—	.5 (13)	.3 (7)	17.9 (8)	2 @ 1.5 (37) 1 @ 1.1 (28)
	480V	10 – 20													
FR6	230V	15, 20	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	2.7 (68)	6.7 (171)	7.6 (195)	5.8 (148)	—	.7 (18)	.4 (9)	40.8 (19)	3 @ 1.5 (37)
	480V	25 – 40													

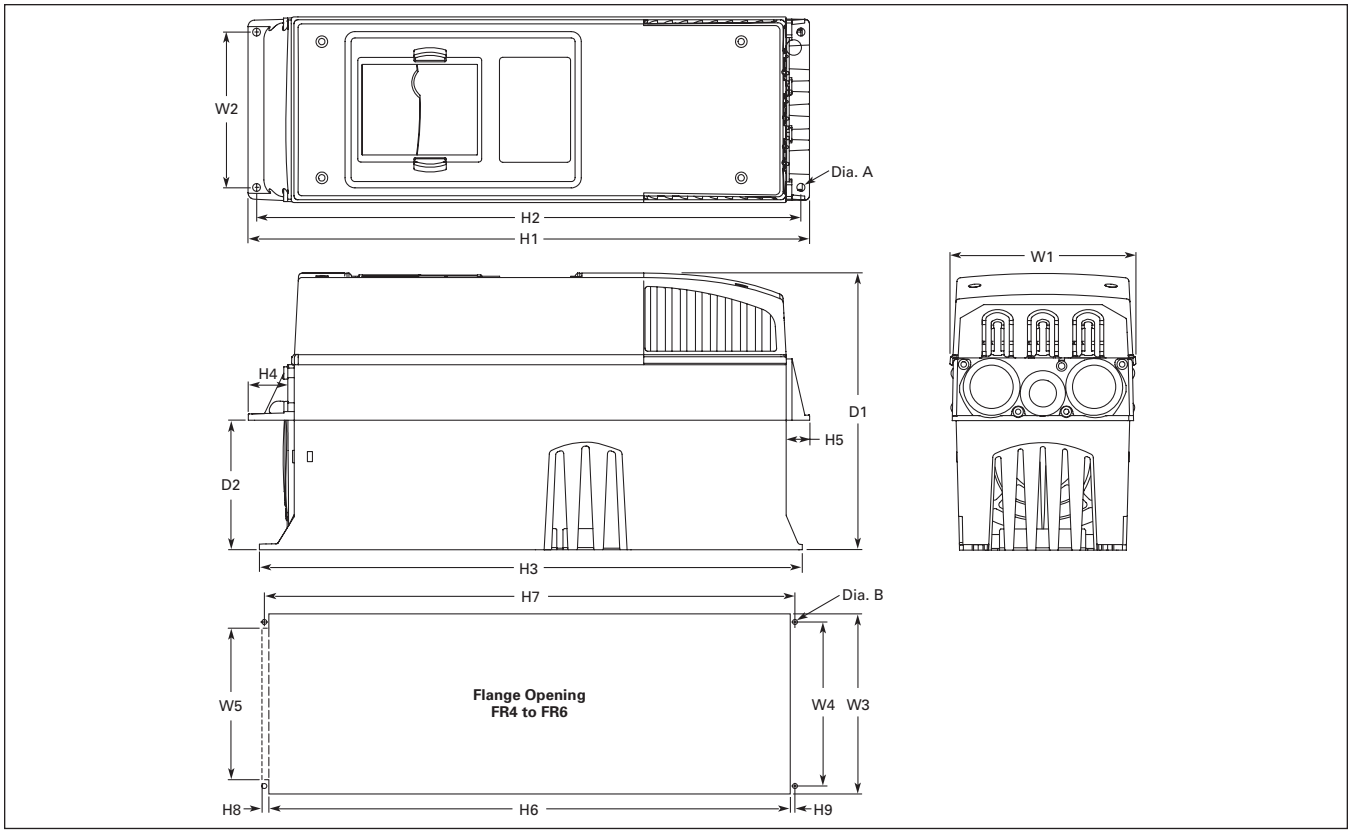


Figure A-8: BAC Open VFD Dimensions, TYPE 1 and TYPE 12 with Flange Kit, FR4, FR5 and FR6

Table A-6: Dimensions for BAC Open VFD, FR4, FR5 and FR6 with Flange Kit

Frame Size	Voltage	Approximate Dimensions in Inches (mm)									
		W1	W2	H1	H2	H3	H4	H5	D1	D2	Dia. A
FR4	230V	5.0 (128)	4.5 (113)	13.3 (337)	12.8 (325)	12.9 (327)	1.2 (30)	.9 (22)	7.5 (190)	3.0 (77)	.3 (7)
	480V										
FR5	230V	5.7 (144)	4.7 (120)	17.0 (434)	16.5 (420)	16.5 (419)	1.4 (36)	.7 (18)	8.4 (214)	3.9 (100)	.3 (7)
	480V										
FR6	230V	7.7 (195)	6.7 (170)	22.0 (560)	21.6 (549)	22.0 (558)	1.2 (30)	.8 (20)	9.3 (237)	4.2 (106)	.3 (7)
	480V										
	575V										

Table A-7: Dimensions for the Flange Opening, FR4 to FR6

Frame Size	Voltage	Approximate Dimensions in Inches (mm)							
		W3	W4	W5	H6	H7	H8	H9	Dia. B
FR4	230V	4.8 (123)	4.5 (113)	—	12.4 (315)	12.8 (325)	—	.2 (5)	.3 (7)
	480V								
FR5	230V	5.3 (135)	4.7 (120)	—	16.2 (410)	16.5 (420)	—	.2 (5)	.3 (7)
	480V								
FR6	230V	7.3 (185)	6.7 (170)	6.2 (157)	21.2 (539)	21.6 (549)	.3 (7)	.2 (5)	.3 (7)
	480V								
	575V								

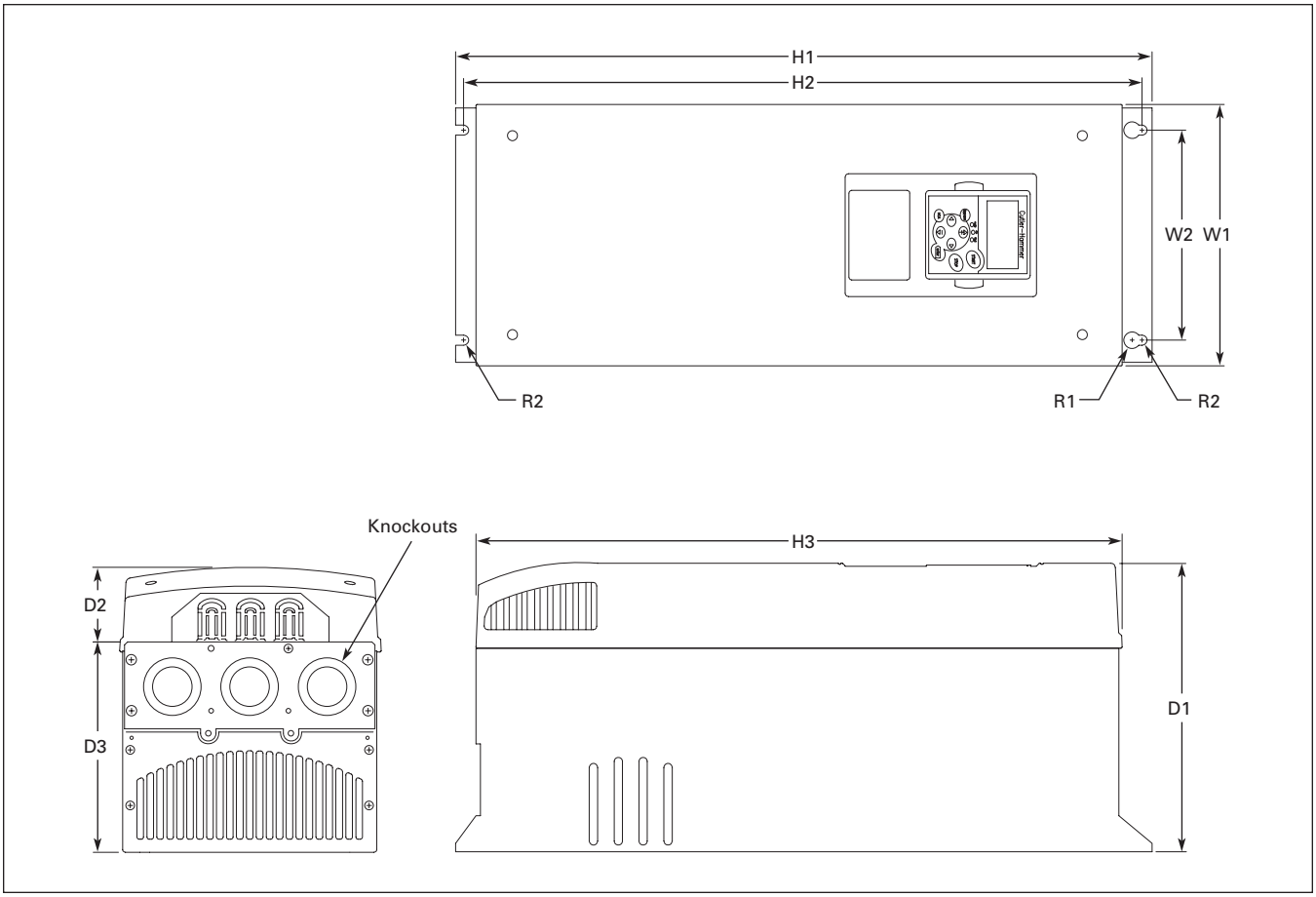


Figure A-9: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR7

Table A-8: BAC Open VFD Dimensions, FR7

Frame Size	Voltage	hp (VT)	Approximate Dimensions in Inches (mm)										Weight Lbs. (kg)	Knockouts @ Inches (mm)
			H1	H2	H3	D1	D2	D3	W1	W2	R1 dia.	R2 dia.		N1 (O.D.)
FR7	230V	25 – 40	24.8 (630)	24.2 (614)	23.3 (591)	10.1 (257)	2.7 (68)	7.5 (190)	9.3 (237)	7.5 (190)	.7 (18)	.4 (9)	77.2 (35)	3 @ 1.85 (47)
	480V	50 – 75												
	575V	40 – 50												

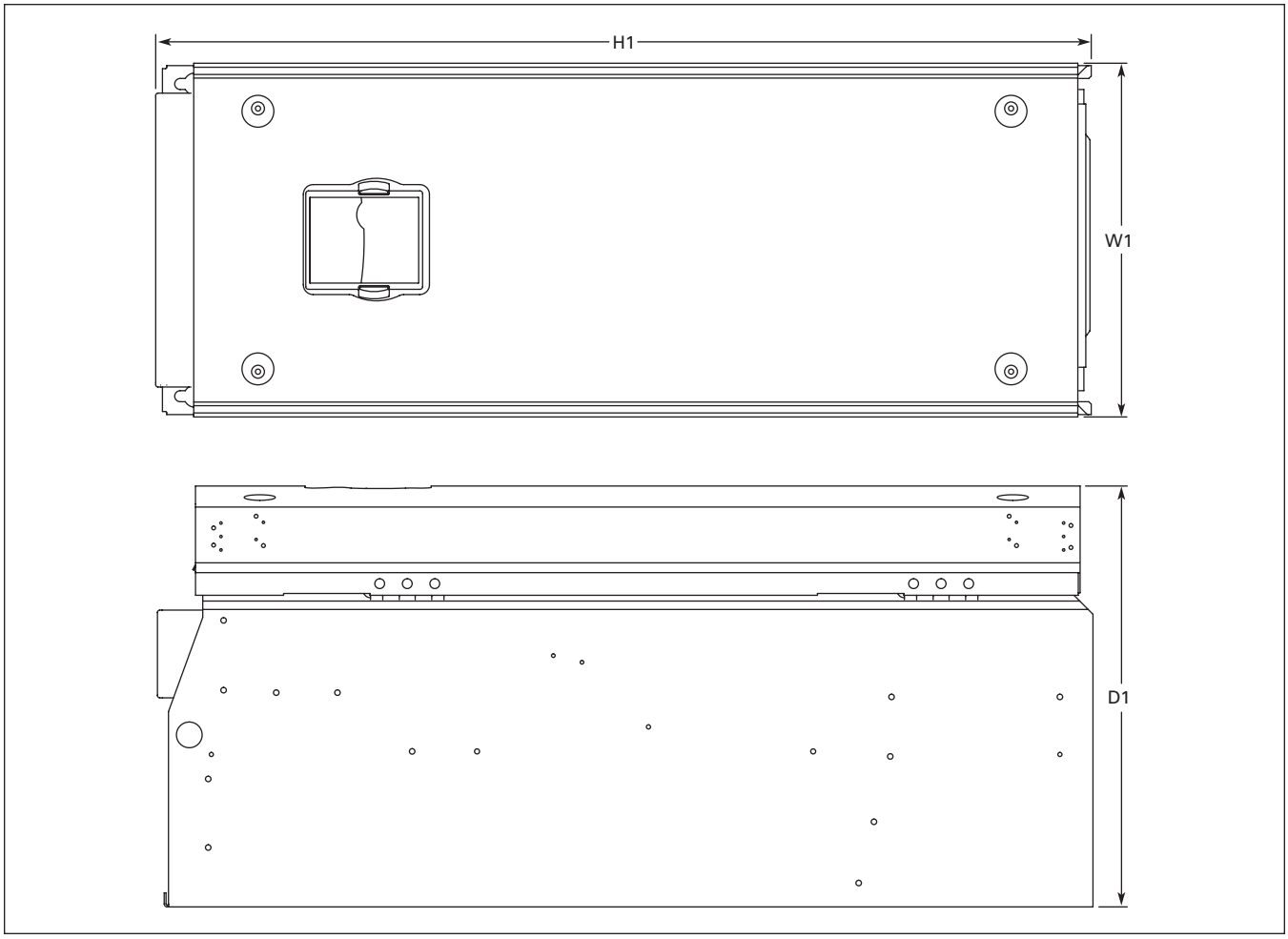


Figure A-10: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR8

Table A-9: BAC Open VFD Dimensions, FR8

Frame Size	Voltage	hp (VT)	Approximate Dimensions in Inches (mm)			Knockout @ Inches (mm)
			D1	H1	W1	
FR8	230V	50 – 75	13.5 (344)	30.1 (764)	11.4 (289)	
	480V	100 – 150				3 @ 1.1 (28)
	575V	60 – 100				2 @ 2.32 (59)

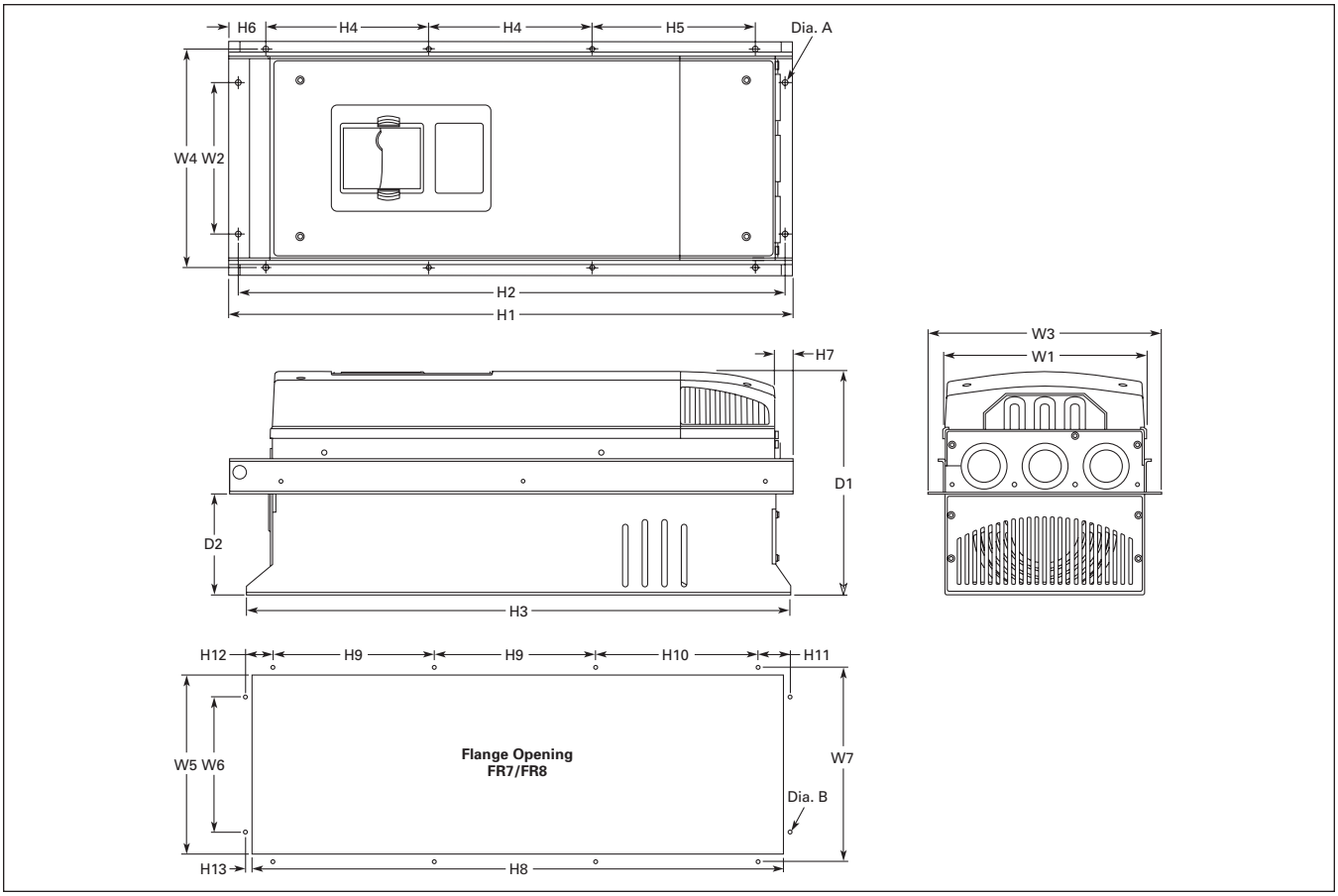


Figure A-11: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, with Flange Kit, FR7 and FR8

Table A-10: Dimensions for BAC Open VFD, FR7 and FR8 with Flange Kit

Frame Size	Voltage	Approximate Dimensions in Inches (mm)													
		W1	W2	W3	W4	H1	H2	H3	H4	H5	H6	H7	D1	D2	Dia. A
FR7	230V	9.3 (237)	6.8 (175)	10.6 (270)	10.0 (253)	25.6 (652)	24.8 (632)	24.8 (630)	7.4 (189)	7.4 (189)	.9 (23)	.8 (20)	10.1 (257)	4.6 (117)	.3 (6)
	480V														
	575V														
FR8	480V	11.2 (285)	—	14.0 (355)	13.0 (330)	32.8 (832)	—	29.3 (745)	10.2 (258)	10.4 (265)	1.7 (43)	2.2 (57)	13.5 (344)	4.3 (110)	.4 (9)
	575V														

Table A-11: Dimensions for the Flange Opening, FR7/FR8

Frame Size	Voltage	Approximate Dimensions in Inches (mm)									
		W5	W6	W7	H8	H9	H10	H11	H12	H13	Dia. B
FR7	230V	9.2 (233)	6.9 (175)	10.0 (253)	24.4 (619)	7.4 (189)	7.4 (189)	1.4 (35)	1.3 (32)	.3 (7)	.3 (6)
	480V										
	575V										
FR8	230V	11.9 (301)	—	13.0 (330)	31.9 (810)	10.2 (258)	10.4 (265)	—	—	—	.4 (9)
	480V										
	575V										

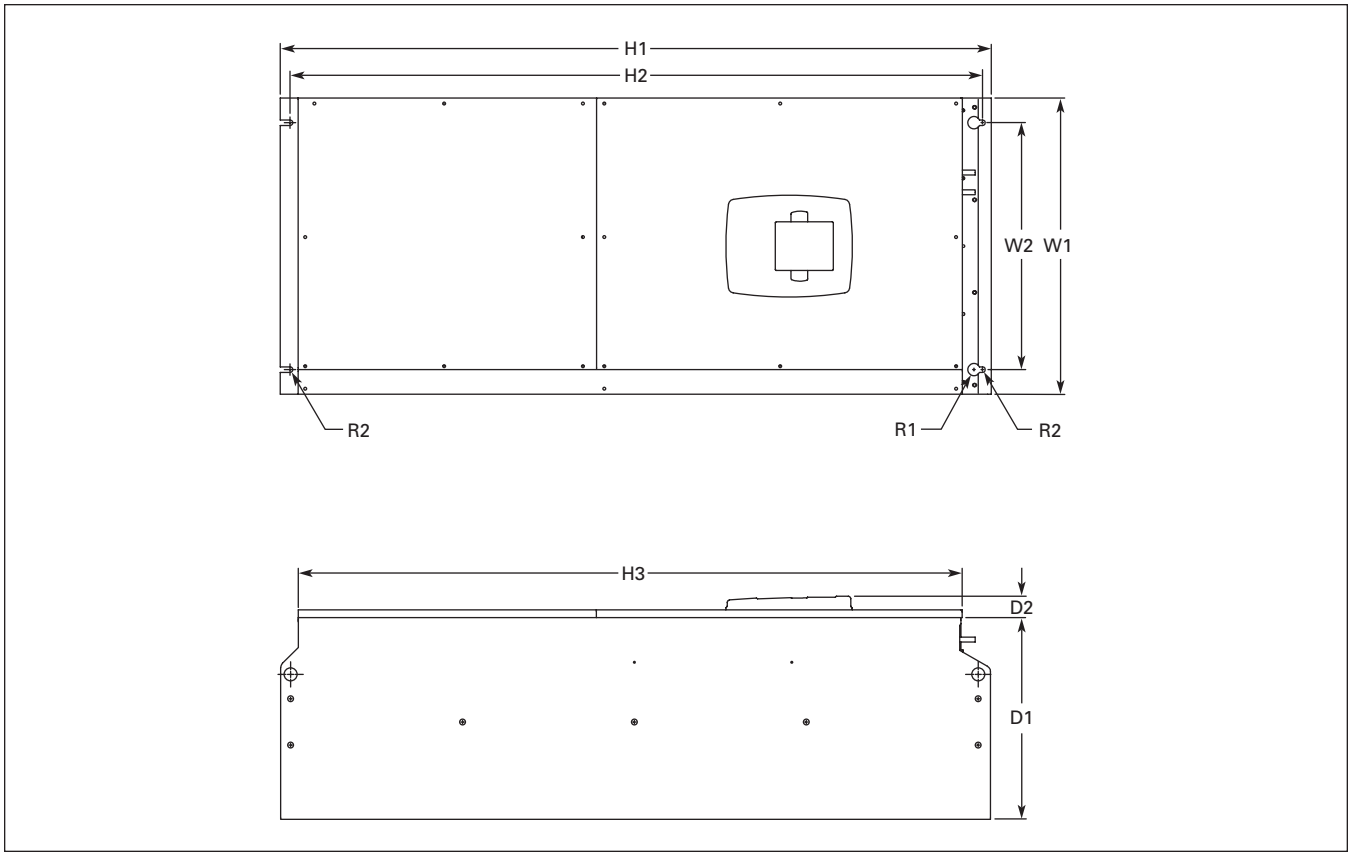


Figure A-12: BAC Open VFD Dimensions, TYPE 1 and TYPE 12, FR9

Table A-12: BAC Open VFD Dimensions, FR9

Frame Size	Voltage	hp (VT)	Approximate Dimensions in Inches (mm)								
			H1	H2	H3	D1	D2	W1	W2	R1 dia.	R2 dia.
FR9	480	200 – 250	45.3 (1152)	44.2 (1122)	42.4 (1076)	12.9 (327)	1.4 (35)	18.9 (480)	15.7 (400)	.8 (20)	.4 (9)
	575	125 – 200									

EMC Capability

General

For products used within the European Community (EC), the Electro Magnetic Compatibility (EMC) directive states that the electrical equipment must not disturb the environment and must be immune to other Electro Magnetic Disturbances in the environment.

The design intent was to develop a family of drives, which is user friendly and cost effective, while fulfilling the user's needs. EMC compliance was a major consideration from the outset of the design.

The BAC Drives are is targeted at the world market. To ensure maximum flexibility, yet meet the EMC needs of different regions, all drives meet the highest immunity levels, while emission levels meet the requirements noted in the following section.

EMC Classification

The BAC VFDs are EMC classification H capable.

Class H:

BAC VFDs have been designed to fulfill the requirements of the product standard EN 61800-3_A11 for the 1st environment restricted distribution and the 2nd environment.

The emission levels correspond to the requirements of EN 61000-6-4.

BAC VFDs fulfill all applicable EMC immunity requirements (standards EN 61000-6-1, EN 61000-6-2 and EN 61800-3+A11).

Declaration of Conformity

The Manufacturer's Declarations of Conformity assuring the compliance of the BAC VFDs with the European Community (EC) EMC-directives is available upon request.

Warranty and Liability Information

Baltimore Aircoil Company warrants the product delivered in the Baltimore Aircoil Company shipping package to be free from defects in material and workmanship, under normal use and service, for twenty four (24) months from date of manufacturing. Products that fail during this period will be repaired or replaced at Baltimore Aircoil Company discretion, with the same or a functionally equivalent product, provided the original purchaser (A) returns the failed product, and (B) provides proof of original date of purchase. This warranty does not apply, in the judgment of Baltimore Aircoil Company, to damage caused during shipment, handling, storage, or accidental misuse. The original purchaser of the product must obtain a Baltimore Aircoil Company Return Material Authorization (RMA) number prior to returning any defective product. (When purchased through an Authorized Distributor, the Distributor should supply an RMA number to their customer.)

The maximum liability of this warranty is limited to the purchase price of the product. In no event, regardless of cause, shall Baltimore Aircoil Company or Eaton Electrical Inc. be liable (a) for penalties or penalty clauses of any description, or (b) for certification not otherwise specifically provided herein and/or indemnification of purchaser or others for costs, damages or expenses, each arising out of or related to the product or services of any order or (c) for any damages resulting from loss of profits, use of products or for any incidental indirect or consequential damages, even if advised of the possibility of such damages.

Appendix B — Fault and Warning Codes

Table B-1: Fault Codes

Fault Code	Fault	Possible Cause	Solution
1	Overcurrent	BAC VFD has detected a high current (>4xI_n) in its output due to: • sudden heavy load increase • short in the motor • short in the cables to the motor • unsuitable motor	Check loading. Check motor. Check cables.
2	Overvoltage	The DC-link voltage has exceeded its high limit due to: • too short a deceleration time • high voltage levels or surges in the utility supply	Make the deceleration time longer. Use brake chopper and brake resistor (standard on some models, available as options on others). Correct utility supply voltage (level is too high). Add input impedance to limit surges.
3	Ground (Earth) Fault	Current sensing indicates that the sum of motor phase currents is not zero. • insulation failure in motor or motor cables	Check motor and motor cables.
5	Charging Switch	The charging switch was open, when the START command was given due to: • faulty operation • component failure	Reset the fault and restart. Should the fault re-occur, contact your Baltimore Aircoil Company distributor.
6	Emergency stop	An Emergency stop signal was received from one of the digital inputs	Determine reason for the Emergency stop and remedy it.
7	Saturation trip	• defective component • motor or motor cable short	Cannot be reset from the keypad. Switch off power. IF THE PROBLEM IS NOT IN THE MOTOR OR ITS CABLES, DO NOT RE-CONNECT POWER! Contact your Baltimore Aircoil Company distributor. If this fault appears simultaneously with Fault 1, check the motor and motor cables.
8	System fault	• component failure • faulty operation **Note:** exceptional fault data record, see Active Fault Menu for more information	Reset the fault and restart. Should the fault re-occur, contact your Baltimore Aircoil Company distributor.

Table B-1: Fault Codes, continued

Fault Code	Fault	Possible Cause	Solution
9	Undervoltage	DC-link voltage is less than the minimum safe operating voltage limit • most probable cause: too low a utility supply voltage • BAC VFD internal fault	If there was a supply voltage loss or dip, reset the fault and restart the BAC VFD. Check the supply voltage. If it was within specification at the time of the fault, an internal failure has occurred. Contact your Baltimore Aircoil Company distributor.
10	Input line supervision	Input line phase is low or missing.	Check the utility supply voltage, cables and connections.
11	Output phase supervision	Current sensing indicates that there is no current in one motor phase	Check the motor cables, connections and motor.
12	Brake chopper supervision	• no brake resistor installed • brake resistor is broken • brake chopper failure	Check the brake resistor. If the resistor is ok, the chopper is faulty. Contact your Baltimore Aircoil Company distributor.
13	BAC VFD undertemperature	Heatsink temperature is under -10°C	Provide supplemental heating or relocate the BAC VFD to a warmer location.
14	BAC VFD overtemperature	Heatsink temperature is over 90°C.	An overtemperature warning is issued when the heatsink temperature exceeds 85°C, a fault occurs at 90°C. Check for the correct amount and unrestricted flow of cooling air. Check the heatsink for dust or dirt buildup. Check the highest ambient temperature level. Make sure that the switching frequency is not set too high in relation to the ambient temperature and motor load.
15	Motor stalled	• motor or load mechanical failure • load too high • stall parameter settings incorrect	Check the motor, mechanical system and load level. Confirm the stall parameter settings.
16	Motor overtemperature	• motor is overloaded • motor overheating has been detected by BAC VFD motor temperature model	Decrease the motor load. If no motor overload exists, check the temperature model parameters.
17	Motor underload	• mechanical or load problem • underload parameter settings incorrect	Check the motor for a loose belt, broken coupling or load problems. Confirm underload parameter settings.

Table B-1: Fault Codes, continued

Fault Code	Fault	Possible Cause	Solution
22 23	EEPROM checksum fault	Parameter save fault • faulty operation • component failure	Upon reset of this fault, the BAC VFD will automatically reload the parameter default settings. Check all parameter settings after reset. If the fault reoccurs, contact your Baltimore Aircoil Company distributor.
25	Microprocessor watchdog fault	• faulty operation • component failure	Reset the fault and restart. If the fault reoccurs, contact your Baltimore Aircoil Company distributor.
26	Start-up prevented	Start-up of the drive has been prevented.	Check Start Enable/Interlock settings.
29	Thermistor fault	The thermistor input of an option board has detected a high motor temperature	Check the motor cooling and the motor loading. Check the thermistor connection. (If the thermistor input of an option board is not being used, it must be short-circuited.)
32	Fan cooling	The BAC VFD cooling fan did not start when commanded	Contact your Baltimore Aircoil Company distributor.
34	CAN bus communication	Sent message not acknowledged	Ensure that there is another device on the bus with the appropriate configuration.
36	Control unit	Control unit cannot control the power unit and vise-versa	Change control unit.
37	Device change	• option board changed • different power rating of drive	Reset. **Note:** No fault time data record!
38	Device added	• option board added • drive of different power rating added	Reset. **Note:** No fault time data record!
39	Device removed	• option board removed • drive removed	Reset. **Note:** No fault time data record!
40	Device unknown	Unknown option board or drive	Contact your Baltimore Aircoil Company distributor.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected high short term overload current	Check loading. Check motor size.
42	Brake resistor overtemperature	Brake resistor overtemperature protection has detected excessive braking	Set the deceleration time longer. Use an external brake resistor.

Table B-1: Fault Codes, continued

Fault Code	Fault	Possible Cause	Solution
43	Encoder fault	**Note:** the exceptional Fault data record. See Active Fault Menu for more information. Additional codes: 1 Encoder 1 channel A is missing 2 Encoder 1 channel B is missing 3 Both encoder 1 channels are missing 4 Encoder reversed	Check encoder channel connections. Check the encoder board.
50	Analog input I_{in} < 4 mA (for signal range 4 to 20 mA)	Current at the analog input is < 4 mA • control cable is broken or loose • signal source has failed	Check the current loop, signal source and wiring.
51	External fault	Digital input set as an external fault input has been triggered.	Check source of trigger.
52	Keypad communication fault	The connection between the control keypad and the BAC VFD has been lost.	Check keypad connection and keypad cable.
53	Communication bus fault	The data connection between the communication bus master and the communication bus board has failed	Check installation. If installation is correct, contact your Baltimore Aircoil Company distributor.
54	Slot fault	Defective option board or slot	Check that the board is properly installed and seated in slot. If installation is correct, contact your Baltimore Aircoil Company distributor.
57	Vibration Cutout	Vibration Cut Out Switch (VCOS)	Determine cause of vibration, repair and reset VCOS signal.
82	BypassOverLoad	The motor has been overloaded while connected to the bypass	Decrease the motor load. Disable the Current Imbalance feature – see the ***IT.*** manual.

August 2006

Appendix C — Accessories

RS-232 Cables Used with BAC VFDs

Communication with PC

When communicating using BAC VFD software tools 9000XDrive or 9000XLoad, a cable with three wires and 9-pin D-connectors is used. See **Figure C-1**.

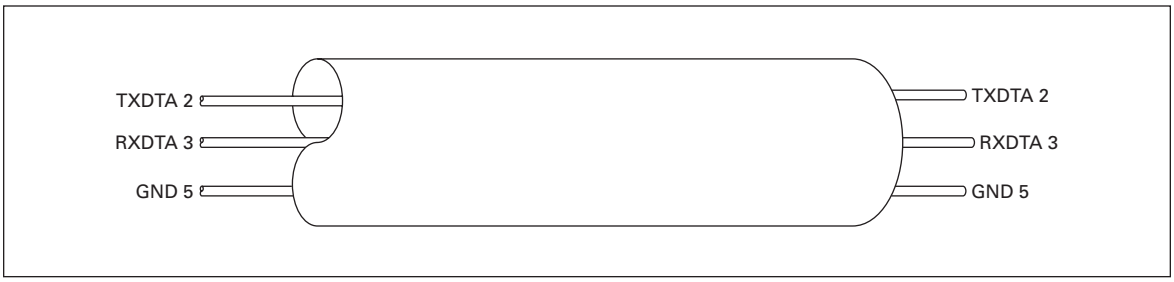


Figure C-1: RS-232 Cable for Parameter Setting or Software Downloading by Using PC

Remote Assembly of the Control Panel

When units are installed inside the cabinet, the keypad is often preferred mounted on the door of the cabinet to make programming and monitoring possible without opening the door. The keypad remote installation can be done with a similar pin-to-pin connected RS-232 cable as the PC-connection, with two additional wires (+12V, -12V) connected to the pins #6 and #9, feeding power to the keypad.

Note: When using these cables for PC-connection you have to check first whether the +12V / -12V lines can cause problems/damages in RS-232 output of PC/laptop. In some PC outputs, ±12V can generate extra current loops which might cause overheating of the components.

Figure C-2: Connection of Cable Used with Keypad

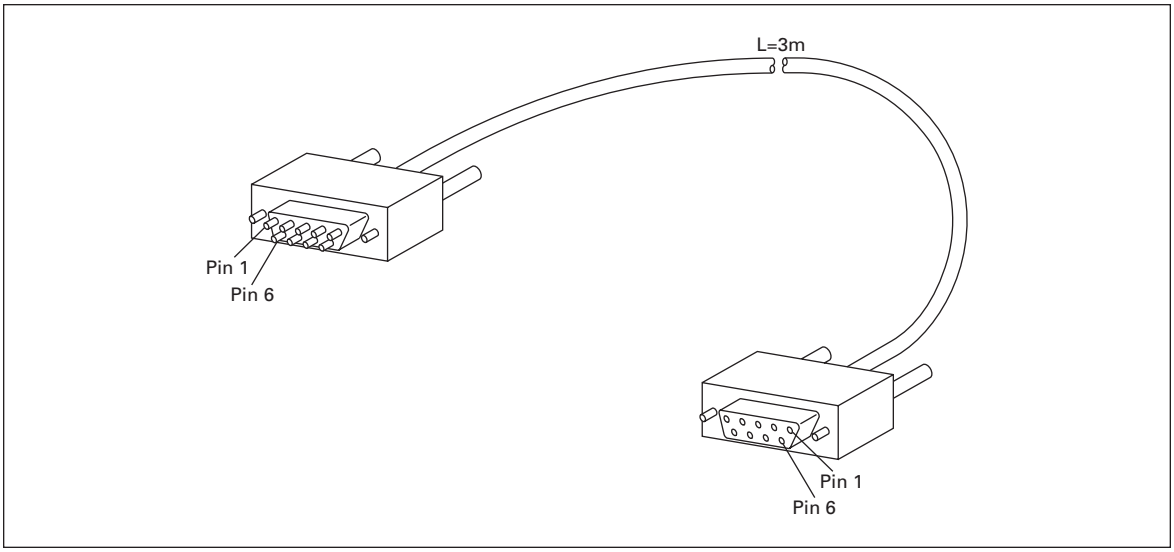


Figure C-3: RS-232 Cable

Appendix D — Wiring Diagrams

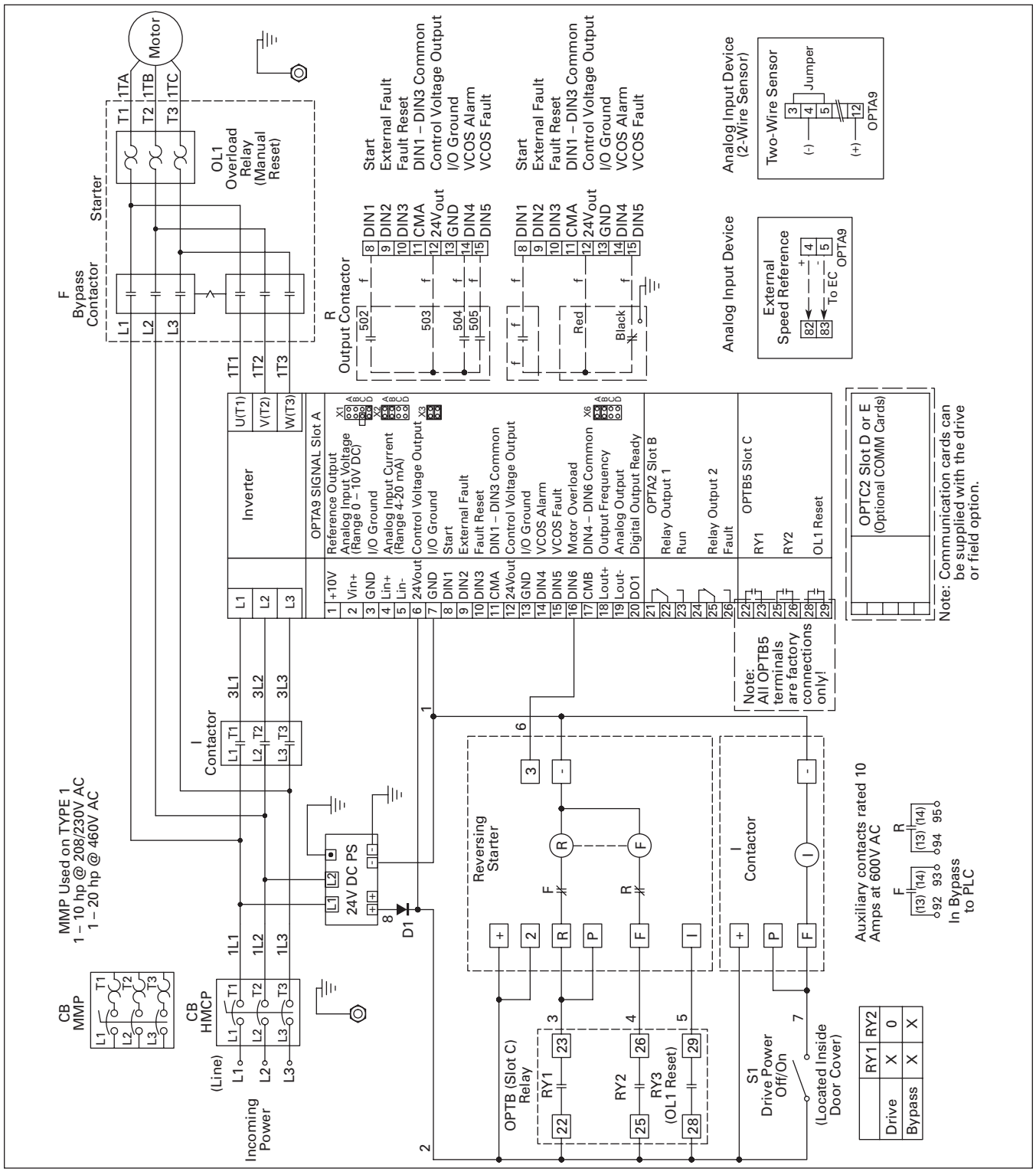


Figure D-1: VFD Wiring Diagram (Standard)

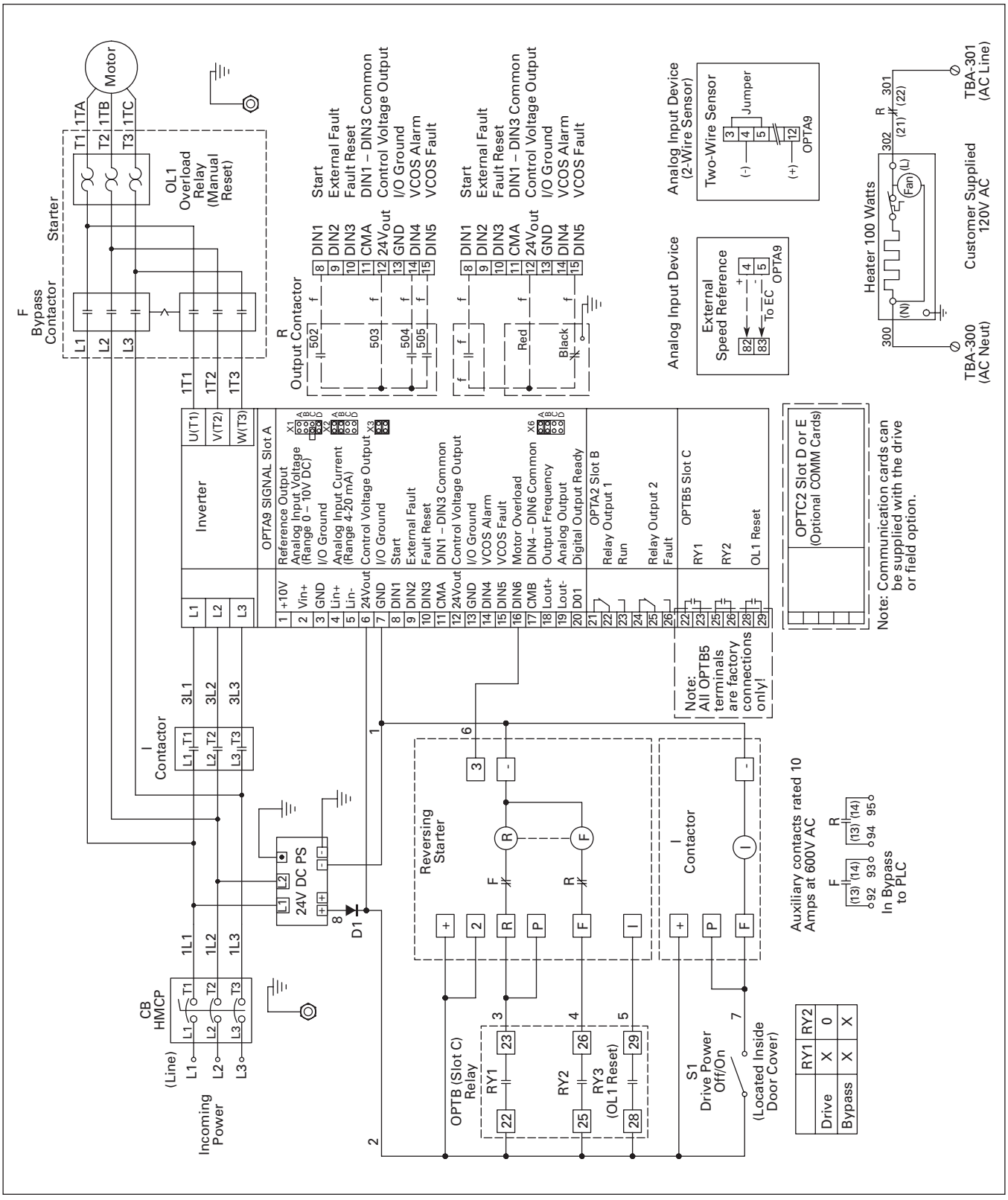


Figure D-2: VFD Wiring Diagram with Enclosure Heater

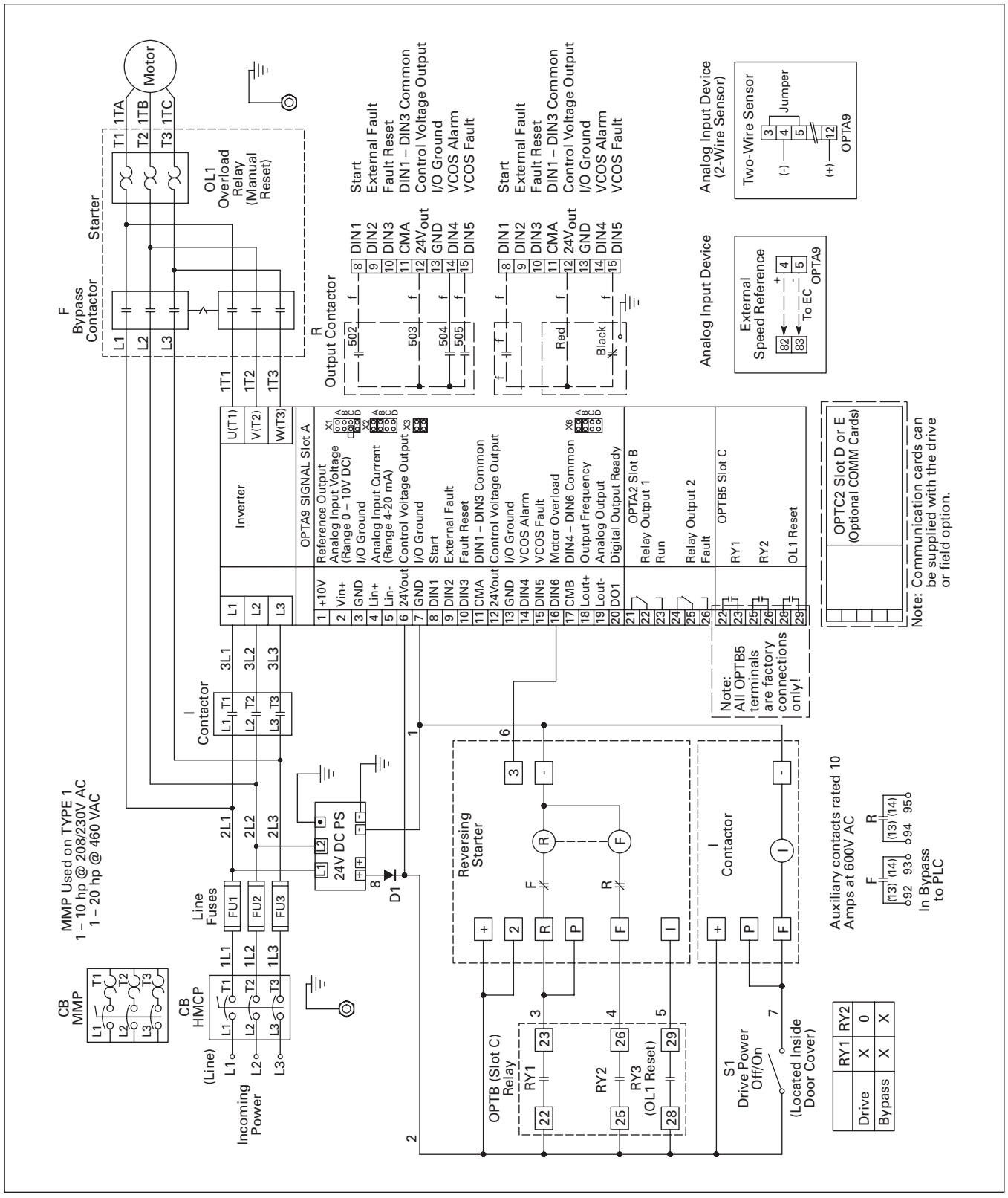


Figure D-3: VFD Wiring Diagram with Line Side Fuses

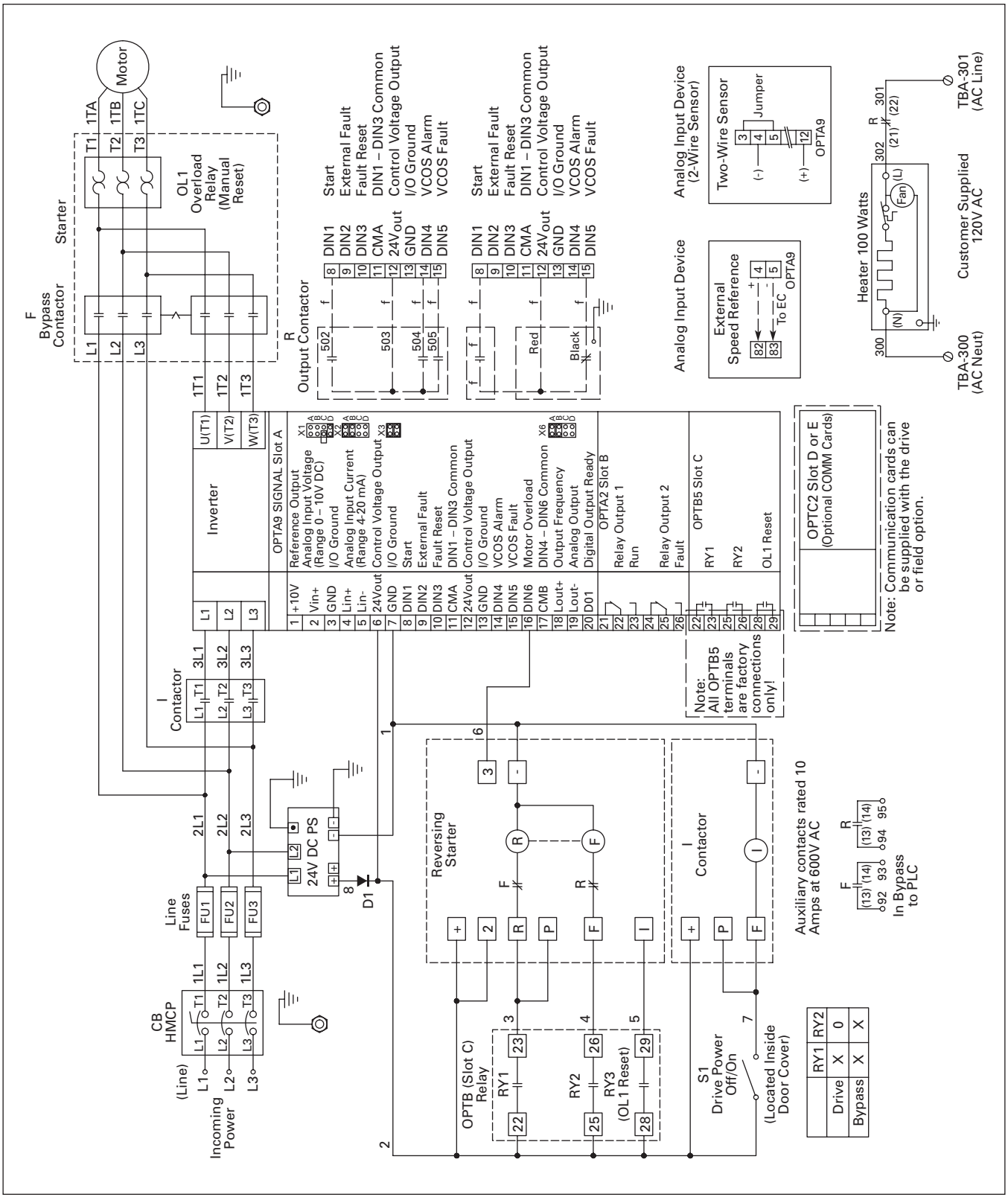


Figure D-4: VFD Wiring Diagram with Enclosure Heater and Line Side Fuses

Baltimore Aircoil Company provides a full range of control panels, engineered to meet your particular application. BAC control panels are specifically designed to work seamlessly with all BAC units — including cooling towers, closed circuit towers, and evaporative condensers — and are fully warranted by BAC, the industry leader. Insist on BAC controls for a complete, single-source solution for all of your evaporative cooling projects.

Since its founding in 1938, Baltimore Aircoil Company has specialized in the design and manufacture of evaporative cooling and heat transfer equipment, and has become a world leader in this field. BAC's continuing program of research and development has produced many innovations which have evolved to become the standards of the industry. To learn more about BAC as a company, or for more information on BAC controls and BAC evaporative cooling equipment, please visit Baltimore Aircoil.com

Baltimore Aircoil Company
P.O. Box 7322
Baltimore, MD 21227
USA
Tel: 410-799-6200
FAX: 800-992-0680
BaltimoreAircoil.com

Baltimore Aircoil Company

© 2006 Baltimore Aircoil Company
All Rights Reserved
Printed in USA
Publication No. M800/1A / CPG
August 2006